DOCUMENT RESUME

ED 161 727 SE 025 192

TITLE Energy Conservation Activities for the Classroom K-12.
INSTITUTION Kentucky Dept. of Energy, Frankfort.; Kentucky State Dept. of Education, Frankfort.
PUB DATE [78]
NOTE 244p.

EDRS PRICE MF-$0.83 HC-$12.71 Plus Postage.
DESCRIPTORS *Conservation Education; Curriculum Guides; Elementary Secondary Education; *Energy Conservation; *Environmental Education; *Learning Activities; *Science Activities; Science Education; Teaching Guides

ABSTRACT

After a brief introduction entitled "Where Does the Energy We Use Come From," this unit presents 86 activities. Each activity gives the title, concept, objectives, subject area, level, time involved, materials needed, procedures, and related career activities. Topics cover everything from housing insulation to alternate sources of energy to energy use by appliances and automobiles. The activities include game playing, science experiments, surveys, field trips, and others. The unit concludes with a bibliography. (BB)

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Energy Conservation Activities for the Classroom K-12

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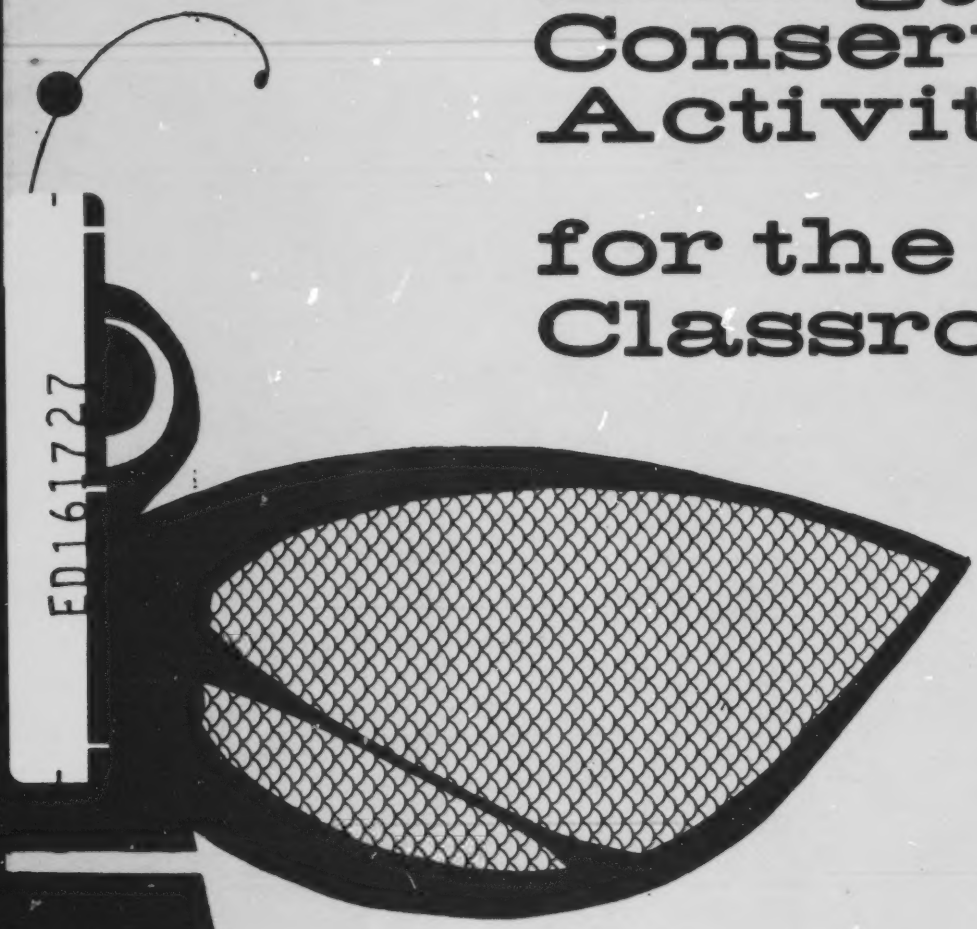

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Kentucky Department of Education
James B. Graham, Superintendent of Public Instruction

in cooperation with
Kentucky Department of Energy
Damon Harrison, Commissioner

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INTRODUCTION

ENERGY EDUCATION CURRICULUM DEVELOPMENT
IN
KENTUCKY

Rationale

Throughout our history the American educational system has been challenged to help solve problems, especially those whose effects have been perceived to be continual and far-reaching. Schools, the mainstream of educational activity and their curricula, the "what" of learning, have been influenced by both societal problems and advancements.

The energy problem confronts the educator with the task of clarifying the role and importance of energy in our daily lives. Schools are called upon to provide creative thinking in all phases of education with an emphasis on exploration, problem-solving, and conservation. An energy conservation attitude or ethic must evolve from this process and must demonstrate that regardless of individual values and life styles energy must be used more efficiently.

Students in our elementary and secondary schools are somewhat aware of the immediacy of the crisis and the diversity of the solutions proposed. They realize to a certain extent that "energy" is a factor in determing their present and future life styles. However, the word "energy" means many different things to different students and since most forms of energy are not visible, it is easy to take them for granted.

To one child, "energy" could mean gasoline to run the family car or the family's three cars. To another, it means a light bulb, a television set, or the "go power" of a chocolate bar or breakfast cereal. A high school physics class may understand energy simply to be "the ability to do work." Students need to know that energy is all of these things and

that whatever our background, wherever we live, or whatever our aspirations, we can never ignore the interrelationships that exist between energy, our environment, and ourselves.

Project Background

The development of an energy education program in Kentucky is beginning. It has begun with a cooperative effort from the Kentucky Department of Education and the Kentucky Department of Energy. In developing Kentucky's State Energy Conservation Plan, the Department of Energy involved the Department of Education in two programs, one dealing with energy conservation in school facilities along with the development of appropriate techniques for infusing energy concepts into the curricula of the elementary and secondary schools of the Commonwealth.

This source book is the beginning of the energy education curriculum development process. The materials and activities outlined within will serve as the basis of the Department of Education's involvement in this vital process while they can provide local schools with assistance in intergrating energy education into their own curriculum programs.

The ultimate goal of this program and all of those that follow is the development of a conservation ethic. Such an attitudinal adjustment will bring about actions effecting a significant reduction in energy consumption and an overall improvement of the quality of life.

Terry L. Wilson
Environmental Education Consultant
Division of Program Development
Bureau of Instruction

ACKNOWLEDGEMENTS

ACKNOWLEDGEMENTS

This source book represents the initial effort of the Kentucky Department of Education in energy conservation curriculum development. It could not have come about without the help of many individuals and contributing organizations.

The activities were compiled by a team of fifteen dedicated classroom teachers who met in two intense writing conferences during the summer and fall of 1977. They were:

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Additional materials used in the development process were provided by:

Center for Environmental Education
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Energy and the Northwest
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A special thanks to Ms. Ann Baker and Mr. Bill Davis of the Department of Education for their efforts in the publishing of this sourcebook.

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WHERE DOES THE ENERGY WE USE COME FROM?

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ENERGY - ENVIRONMENT MINI-UNIT GUIDE
NATIONAL SCIENCE TEACHERS ASSOC.
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Where Does the Energy We Use Come From?

Primary Energy Sources

There are five *primary* sources of energy that are naturally available to us on earth: solar, chemical, nuclear, geothermal, and tidal energy. Two of these, the chemical energy of fossil fuels and nuclear energy are *stored or potential* forms of energy. The other three — solar, geothermal, and tidal energy — are *kinetic* forms of energy; that is forms which are active and always in motion. While we can use the energy in the stored sources of energy whenever we choose, we can use the kinetic forms only when nature makes them available to us; for example, sunlight is only available during daylight hours. In the sections that follow we will briefly discuss each of the primary sources.

Solar energy: Solar energy is a kinetic form of energy. It is more precisely called radiant energy, much of which is observable as visible light. A major portion of the sunlight which approaches earth is reflected by the atmosphere back into space. Although only roughly half of the solar energy reaches the ground, half is still a tremendous amount. If all the solar energy reaching the ground could be stored for 48 minutes, it could provide as much energy as used worldwide in 1970.

A very small part (1/5000) of this energy interacts with plants and fuels the photosynthesis process. Solar energy, thus, is indirectly the source of the food energy on which we depend. It is also the source of the chemical energy which was stored hundreds of millions of years ago in the plant life of the swampy jungles of earth. We are using stored solar energy when we burn the fossil fuels: coal, oil, and natural gas.

The sun's radiant energy also heats the land and the oceans and thus provides the energy for the great air and ocean currents — the winds and waves. Historically, wind and water currents were early sources of energy and were harnessed by windmills, sailboats, and waterwheels. With increases in the world's population and the rise of cities, however, these sources became inadequate. Today we get some of our energy from these wind and water currents in a different manner. Some of the sun's energy evaporates water from lakes and oceans. The water rises and is carried in the winds. If the water falls on the mountains, we get some of the energy for our use by letting the mountain-fed streams and rivers turn the turbines of hydroelectric plants to produce electricity.

Most of the solar energy reaching the ground is unused by man. It is available during the daylight hours throughout the world in varying amounts. However, since it is a kinetic form of energy, it must be used immediately or it must be converted into some potential form of energy for later use. Presently, sunlight is being used as the sole source of heat for a few homes. However, collection and storage of solar energy for later transportation and use is still difficult. In particular, we have not perfected practical and economical methods of collecting solar energy and converting it into electricity. Since the lifetime of the sun is many billions of years, for all practical purposes this energy source will always be with us. It is a *continuous* source of energy which does not need to be renewed.

Fossil fuels: The most important form of stored energy is the chemical potential energy of the fossil fuels: coal, oil, and natural gas. As we have said, this energy was originally solar energy hundreds of millions of years ago. Coal began to be formed when the huge mosses and ferns of the Paleozoic swamps died and fell into the mud. They were acted on by anaerobic bacteria (bacteria which don't need oxygen) and then by pressure and heat as they were buried under tons of sediment and converted to the almost pure carbon of coal. When the carbon atom is burned (oxidized), it releases this stored energy.

Petroleum and natural gas were formed in a similar manner. Some of the plant and animal life sank to the bottom of the great sea beds and went through a different chemical transformation under pressure and heat to form the "hydrocarbons," the complicated molecules of hydrogen and carbon characteristic of petroleum. Their stored energy is also released by burning.

Fossil fuels are used extensively because they are relatively easy to find, collect, store, and transport. Coal, oil, and natural gas resources can be located through geological surveys. Once discovered, the fuels can be removed from the ground by mining or drilling and transported by pipes, truck, rail, etc. to any destination. Although the formation of fossil fuels is continuing, the process is very slow. It would take another 300 million years or so to produce an amount equal to that which has been built up so far. Since our energy use is much more rapid than this, we are likely to use up all of our fossil fuels. For this reason, fossil fuels are called *non-renewable* sources of energy.

Nuclear energy: A form of potential energy which is of growing importance is that stored in nuclei, the tiny, dense cores of atoms. Nuclei are made up of the elementary particles — protons and neutrons. It is by rearranging these particles that nuclear energy is stored and released. There are two important examples of this: the fission reaction and the fusion reaction. In the fission reaction, the heavy nucleus, or center, of an atom such as uranium is split into two lighter ones. In this process, mass is converted into energy and it is this energy we obtain from the hot interior of a nuclear reactor.

The fusion reaction involves very light nuclei. It is the same reaction which is the source of the sun's energy. In a typical example, four hydrogen nuclei, by a complicated series of reactions, combine to form the heavier helium nucleus (two protons and two neutrons). Again, some of the mass has been converted to energy.

Nuclear energy becomes available to us in the nuclear reactor of an electric power plant. The energy of the nuclear reaction heats water, for example, and converts it to steam. This turns a turbine which produces electricity much as a river is used in a hydroelectric power plant.

The electricity is then transmitted to our homes through wires. The major fuel for the fission reaction in nuclear reactors is Uranium 235; it is available in limited quantities throughout the world.

Like the fossil fuels, the nuclear fuels are also presently *non-renewable*. However, if all of the many technical and safety problems of a new type of reactor called the breeder reactor can be overcome, nuclear fuels will be much more plentiful. The breeder reactor, while it uses up some nuclear fuel to produce electricity, produces a by-product which can be reused as a nuclear fuel to produce more electricity.

Geothermal energy: The earth's interior is molten rock, or "magma" as the geologists call it. There is a tremendous amount of energy in the earth. Although heat energy is an active or kinetic form of energy, the heat of the earth is effectively stored and insulated by the solid, thin crust on which we live.

We are not sure how the energy got there. It may have been stored in the molten blob of original earth, or it may have come from the impact of countless chunks of matter pulled to it by the earth's gravity. We are fairly certain that the radioactivity of some of the material in the earth keeps it hot. There seems to be enough uranium, radium, and other naturally radioactive material in the earth's interior to produce that relatively small amount of heat needed to make up for that lost through the surface. In this sense, geothermal energy does not need to be renewed and is essentially a *continuous* source.

The geological conditions which produce geothermal energy restrict this energy source to a few geographic areas. Where available, it is inexpensive, clean, and has few adverse environmental effects. It is available to us in those regions where the magma is close to the surface and the energy can leak out from the core through cracks in the crust. Volcanoes, geysers and hot springs are visible evidence of geothermal reservoirs, but more sophisticated techniques will soon allow us to find others not evident on the earth's surface. If available as hot water or steam, geothermal energy can be used to heat buildings. Some 500 homes and offices in Klamath Falls, Oregon, are heated by hot water drawn from a hot spring running under the town. The only large-scale use of it is in The Geysers in California where dry steam — steam so hot there are no water droplets in it — is piped to steam turbines and used to generate electricity.

Tidal energy: The last of the big five, tidal energy, is probably of least importance for our use. The source of this energy is the kinetic energy stored in the rotation of the earth-moon system. Like geothermal energy, it is another example of the successful temporary storage of energy in the kinetic form. It is *continuous* and does not need to be renewed. This energy is converted to motion of the oceans through the gravitational attraction of the moon on the oceans' contents. Ocean water is pulled toward the moon on the near side (and bulges in the other direction on the far side). To use this tidal energy, the up and down (in and out) motion of the water must be used to turn a turbine and produce electricity. This electricity can then be carried by wires to homes and offices.

Tidal generation of electricity is only practical where geologic peculiarities cause high tides. The first tidal dam and generator were built in the Rance estuary on France's Brittany coast where tides rise and fall an average of 26 feet.

There has also been some interest in building a tidal conversion facility at Passamaquoddy Bay on the far northern coast of Maine, but it does not yet appear commercially usable. We do not expect much contribution to our total supply of energy from this form.

Natural Gas

What Is It?

Natural gas, like coal and oil, is a fossil fuel. A mixture of gases, it is composed mostly of methane, an odorless, colorless, and tasteless gas that is lighter than air. A distinctive odorant is added to natural gas so that people recognize its presence. Conditions similar to those which produce oil also produce natural gas, and they are often, but not always, found together.

Natural gas and oil were formed, it is believed, out of the tiny plants and animals that existed on the land and in the water that covered much of the earth hundreds of millions of years ago. Gradually, the remains of these plants and animals were buried in layer upon layer of sand, mud, and other sediment. Time passed and the pressure, heat, and, perhaps, the action of bacteria and radioactivity changed these remains into oil and natural gas, which collected in layers of porous rock (see Diagram 1). Gas can move more easily through the porous rock than can oil and, as a result, there are many areas of natural gas not associated with oil.

Extracting Gas

Gas is extracted, or removed from the ground, by drilling wells. Geologists (scientists who study the earth and its outer layer) investigate land formations, looking for the kind of rock formations in which oil and gas have been discovered in the past. When a favorable location is found, a gas producing company will lease the mineral rights and proceed to drill a well (see Diagram 2). Drilling equipment is moved to the site and a derrick is erected. The drill bit, or cutting tool, begins to break up the rock and dirt between ground level and the area thought to contain the natural gas. After the dirt and rock are removed, a pipe is lowered into the hole. The average depth of natural gas wells drilled on land in the United States in 1972 was 5,679 feet. (The average depth for offshore natural gas wells was 10,698 feet.) There is never a guarantee that gas and oil will actually be located. Of the 28,449 oil and gas wells drilled from January to November 1974, 10,656 were "dry holes." If gas is found, it rises through the pipe to the surface where it is cleaned. After cleaning, it enters the transmission pipeline. Pumping stations along the way help maintain the pressure necessary to move the gas. It may travel thousands of miles to distribution systems and from there to individual homes or its many other points of use. By 1973, 967,667 miles of pipeline stretched across the United States. Of this total, 265,000 miles were transmission pipelines.

Natural Gas as Heat

Natural gas can heat a home directly or indirectly. A gas furnace can provide the heat that can be used to heat water or air (see Diagram 3). The hot water can be moved via pipes to radiators throughout the house, or the hot air can circulate heat throughout the house via air ducts. Natural gas can also be used to air-condition homes. As with other fossil fuels, it can be changed into electric power and be used to heat or to air-condition homes.

How Much Natural Gas Is Available?

In 1973 natural gas supplied about one-third (30 percent actually) of the nation's total energy. Its percentage share of total energy is expected to decline as new sources become harder to find. One prediction is that by 1990, natural gas will provide only one-quarter of our total energy. This smaller percentage, however, will correspond to more than half again as much gas as was consumed in 1973. It is, therefore, important to know how much gas we have left.

DIAGRAM 1

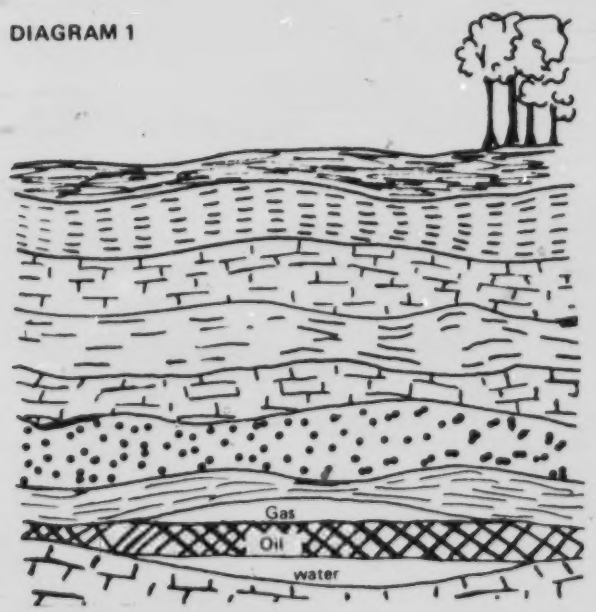
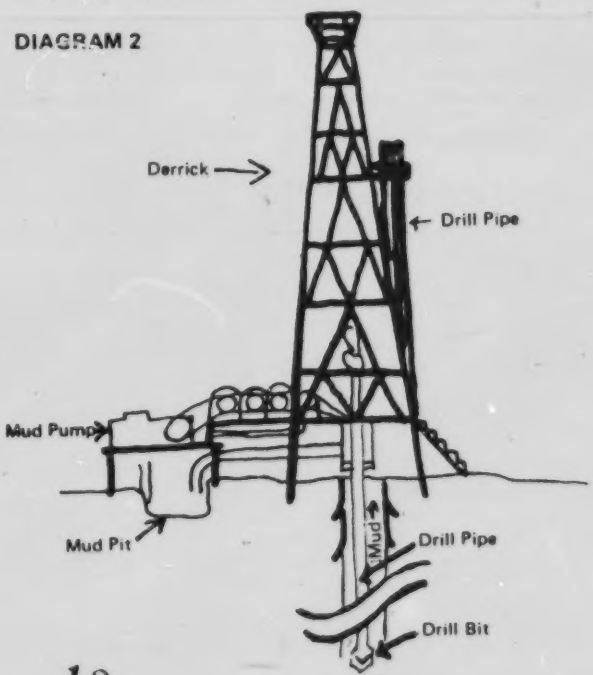


DIAGRAM 2



Some of our natural gas resources were wasted before it was learned how to store and transport the gas found during oil exploration. In the early 1900s, such gas was burned or lost — the know-how and equipment for transporting and using the gas supply were lacking. Between 1935 and 1955, however, a number of pipelines were built from the gas fields of the Southwest and other producing areas throughout the United States. It is now possible to extract and transport 80 percent of the natural gas found. (Coal is recovered at a 50 percent rate and oil at a 33 percent rate.)

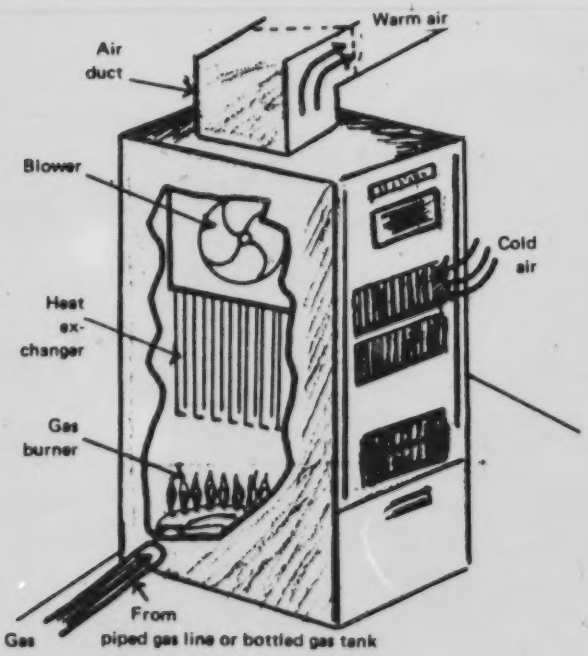
Natural gas has been a preferred fuel during the last 50 years. It is clean, efficient, and causes only a small amount of pollution of the environment. In addition, the Federal Government, which regulates the price of interstate natural gas, has kept gas prices low. We have been using our natural gas supply at an increasing rate. In 1973, the people in the United States used 22.6 trillion cubic feet of gas. (A cubic foot is a block that measures one foot in length, one foot in height, and one foot in depth.) Until the 1970s, gas companies were seeking new customers and building new pipelines. By 1972, however, some gas companies began to refuse new customers and to occasionally interrupt the supply to their larger customers, such as schools and industries.

There is presently no way of knowing exactly how much natural gas, oil, and coal is buried in the earth. Geologists and other scientists concerned with such problems make estimates based upon their knowledge of geological formations that may contain these fossil fuels. These estimates are called "ultimately recoverable resources." For instance, the estimated "ultimately recoverable resources" of natural gas in the lower 48 states and Alaska at the end of 1973 were figured at 2,560 trillion cubic feet*.

When drilling actually produces natural gas in an area previously designated as containing resources, and additional exploratory drilling reveals the size of the gas field, then data are available for a much better estimate of the quantity of natural gas in a given area. Such an estimate is then called a "reserve." Total reserves of natural gas in the lower 48 states and Alaska at the end of 1973 were estimated at 290 trillion cubic feet.

How long these supplies will last depends on how large they actually turn out to be, and on how much we use each year. If we were to continue to use natural gas at the 1973 rate of 22.6 trillion cubic feet per year, the ultimately recoverable resources would last 112 years and the reserves 13 years. If, however, our use of natural gas were to increase each year as fast as it did in the 1960s, even the ultimately recoverable resources would last only 45 years. To make sure that some natural gas is around for the next generation to use we must continue both to look for new supplies and to make sure that we use our present supplies efficiently — primarily for purposes demanding this clean fuel.

DIAGRAM 3



How Much Does It Cost?

As mentioned earlier, the United States Government regulates the price of interstate natural gas at the well. This has kept the price of natural gas low. The cost of heating using natural gas depends upon the size of the house, its geographic location, and the commercial cost of gas. In 1972, the average cost of heating a home with natural gas in our country was about $150.00 (see Table, Regional Annual Average Residential Consumption and Cost of Natural Gas).

In addition a gas furnace can cost from $250 to $500 plus installation charges. It is likely that gas prices will increase in the near future.

*Estimates differ from source to source. These estimates come from Chapter 2, Volume II, of the NSTA *Energy-Environment Source Book*.

Regional Annual Average Residential Consumption and Cost of Natural Gas

Region	Gas Consumption (in Million British Thermal Units*)	Cost
New England	89	$202
Middle Atlantic	104	170
East North Central	164	197
West North Central	154	171
South Atlantic	102	147
East South Central	112	124
West South Central	101	89
Mountain	138	122
Pacific	111	121

Source: American Gas Association, 1972.

* BTU = 0.252 Calories of energy or 1 Calorie equals about 4 BTUs.

What Are the Environmental Effects of Producing and Using Natural Gas?

Natural gas in general has few harmful effects on people or the environment. It is basically a clean fuel, with practically no sulfur impurity and, therefore, contributes little to sulfurous smog. Like any fuel, when it is burned it will produce some of the nitrogen oxides that are part of the "photochemical" smog present in places like Los Angeles.

While safe for household use, natural gas does have explosive potential as the occasional leak-caused home explosion attests. It is not poisonous but can cause death by carbon monoxide poisoning if burned in a poorly ventilated room. About 100 people per year lose their lives from gas explosions and another 230 suffer from carbon monoxide poisoning due to gas fires.

Although many people prefer natural gas because it is clean and environmentally safe, it is presently our most limited fossil fuel resource and cannot be considered the answer to our long-term energy problem.

Oil

What Is Oil?

Oil is one of our most important fuels. In appearance it is a bluish-brown liquid about the consistency of table cream. It is called a fossil fuel because it was formed hundreds of millions of years ago when the seas were filled with tiny, one-celled animals called protozoans. Each protozoan lived in the sea inside a tiny shell and fed on very small sea plants. The unused food was stored in liquid form inside the shells. As these tiny animals died, they dropped to the sea bottom and layers of their remains were built up. With the passage of time, mud, sand, and other sediments buried these layers deep within the earth. Pressure and heat eventually changed the remains into what we now call "oil." It is sometimes found in a "pool" (as shown in Diagram 1), trapped along with gas and salt water under an impenetrable dome of rock. At other times it is not in a definable pool but is absorbed into the cracks and crevices of a porous rock formation.

Extracting Oil

Oil is found by exploratory drilling in an area where geologists (scientists who study the earth and its outer layer) determine that conditions are right for its existence. Equipment and men move onto the site, a derrick (see Diagram 2) is constructed, and well digging begins. There are three major parts of a well. The derrick is a steel structure about 100 feet high that helps raise, lower, and position the pipe. The rotary drill bits are huge, pipe-like steel cones covered with sharp teeth that cut up the rock and dirt so that it can be removed. The drill pipe is a steel pipe about four to six inches in diameter and about 30 feet in length. The drill pipe is rotated, or turned, into the ground by powerful engines. A mixture of water, clay, and chemicals known simply as "mud" is forced through the pipe. This mud cleans and cools the bit and carries the cuttings to the surface. A drill bit can cut into the earth at a rate of about 40 feet per hour before the bit wears out. As the well gets deeper and deeper, additional sections of pipe are added. When a bit does break or wear out, the entire length of pipe must be pulled up and stored and the bit replaced, then the entire pipe is reassembled and lowered. The depth of the average oil well in the United States is about 4,500 feet. The complete job of replacing a drilling bit can take six men at least 10 hours — if all goes well.

Oil as a Source of Heat

Like any fossil fuel, oil must be burned to obtain energy. A sketch of a home oil furnace is shown in Diagram 3. Heat energy released in the burning of oil can be used in two ways: It can be used to heat water and then the water or steam moves into radiators throughout the house; or it can heat air, which circulates through air ducts located throughout the house. The heat from burning oil can also be changed into electricity in large power plants. This electric power can then be sent to homes to run air-conditioners or room electric heaters.

How Much Oil Is Available?

Oil supplied 46 percent of our total energy in 1974 and about half of this was used in transportation. Second only to natural gas in home heating, oil use is expected to increase. It is, therefore, important to know how much is left.

Because we imported so much of our oil, 40 percent in 1974, we have to distinguish between domestic resources — those in the continental United States — and world resources. With imported oil, it is the price

DIAGRAM 1

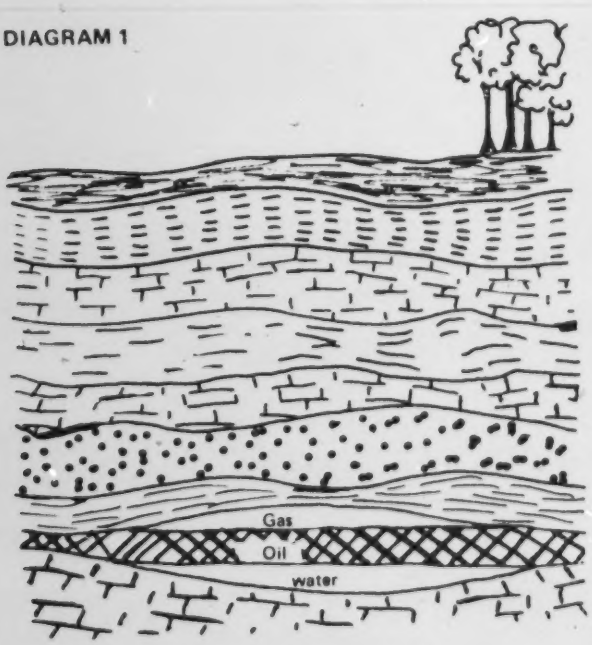
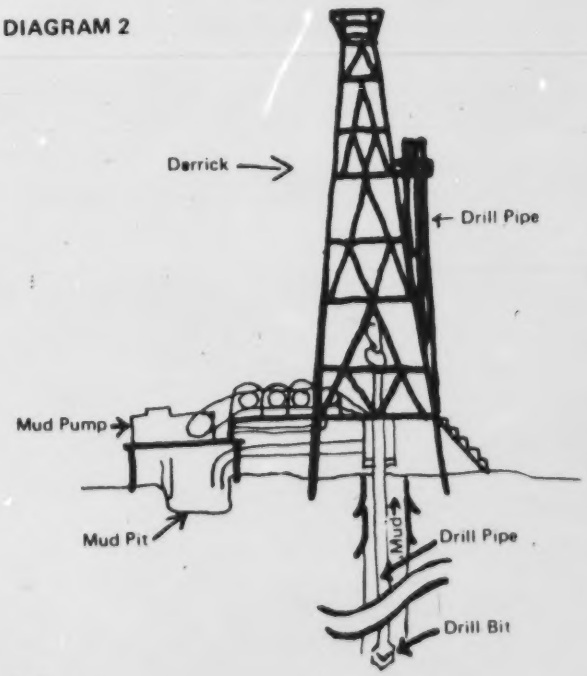


DIAGRAM 2



rather than the amount in the ground that will be important.

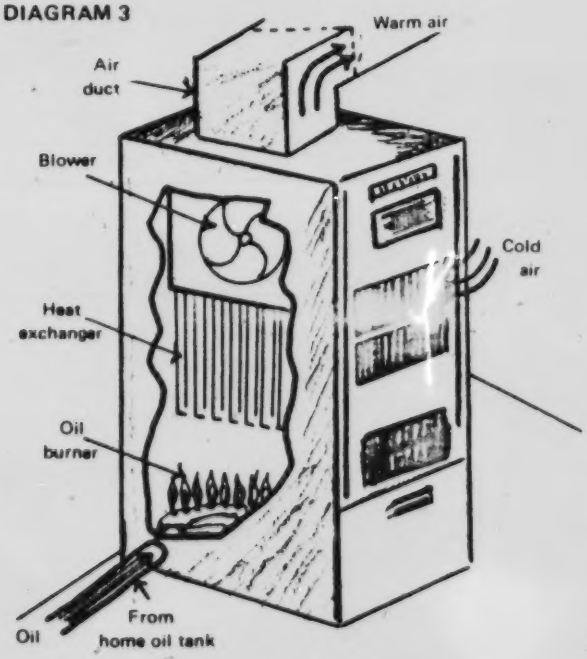
As for our domestic resources, it is difficult to estimate them. We do not really know how much there is until we pump it from the ground. We not only need to discover oil, by exploratory wells such as we have described, but we need to be able to get it out of the ground. Present techniques allow us to get only one barrel out for every three that are in an oil deposit.

We will make the same distinction here that we made in discussing natural gas. We will talk about "ultimately recoverable resources," which are estimates, based on geological studies and the like, of the total amount of oil economically worthwhile and technically possible to recover, and "reserves," which is oil that is found and its extent measured. A present estimate is that there are 52 billion barrels of oil (one barrel is 42 gallons) in the reserve category and 502 billion barrels in the ultimately recoverable resources* category. In 1973 we used 6.3 billion barrels of oil in this country. If we obtained all of that oil from domestic resources and continued using it at the same rate each year, our domestic reserves would last eight years and the ultimately recoverable resources would last 80 years. If we got only half of the supply from United States sources, these numbers would be doubled.

Our use of oil has, of course, been increasing each year, and if this trend continues the supplies will not last as long as current estimates. If our rate of use were to increase as fast as it did in the 1960s and we were to rely on domestic sources alone, even the ultimately recoverable resources would last only 35 or 40 years.

*Estimates differ from source to source. These estimates come from Chapter 2, Volume II, of the NSTA *Energy-Environment Source Book*.

DIAGRAM 3



How Much Does It Cost?

The cost of oil is rising. The cost of an average oil well ranges from $100,000 to $3 million. Most of the oil that was easy to find has been discovered and wells constructed. Offshore and Alaskan sites are likely to be the major sources of oil in the future; as they will be in much harder places to work, their oil will be more expensive.

In 1964 fuel oil cost the consumer about 16 cents per gallon. By 1974 the price had doubled to 35 cents per gallon. Only a small part of the environmental cost of correcting pollution problems is included in the 35-cent price. As these environmental costs are added, we can expect the price of oil to increase some more.

The cost of heating a home with oil varies according to the size of the home, the geographic region, and the current price of oil. The average cost of heating a home with oil is about $300 per year (estimate based on $2.50 per million BTUs* at 1974 Washington, D.C., prices).

What Are the Environmental Effects of Producing and Using Oil?

Oil can harm the environment when it is produced, shipped, or burned. Although land-based wells and land transportation of oil can be messy, offshore or Arctic drilling for oil and its shipment by sea causes most of the environmental worries. Wells leak oil into the ocean or spill it in the occasional blowout. Tankers cleaning out their holds dump oil into the sea or spill it in an accident. In the Arctic, oil spills on the ice take a long time to disappear and pipes, such as the one being built across Alaska, can cause many changes in the land they cross.

Oil refineries, which process the oil to produce gasoline, heating oil, asphalt, and other products, create air and noise pollution as well as waste products, such as sludge and brine, that can create land and water pollution unless controlled.

Air pollution is a major problem. The burning of oil in furnaces adds harmful gases to the environment unless emission controls are added to the system. The Clean

*A BTU is a unit of heat energy equal to about one-fourth a Calorie. It takes about a 100 million BTUs to heat a home for one year.

Regional Costs of Oil Heat

Region	Amount (in Million British Thermal Units)	Heating Cost*
New England	89	$365
Middle Atlantic	104	328
East North Central	164	384
West North Central	154	294
South Atlantic	102	255
East South Central	112	216
West South Central	101	165
Mountain	138	269
Pacific	111	210

* $2.50 per 1,000,000 BTU 1974, Washington, D.C.

Air Act of 1970 has set standards for oil refineries and other manufacturing plants in an attempt to control the emission of harmful gases into the atmosphere. Plants may be fined or closed if they do not comply with state regulations. At present no legislation has been passed to regulate air pollution from individual home furnaces. These harmful gases contribute to a variety of respiratory problems in people and animals.

The Water Quality Act of 1970 was passed to help regulate water pollution caused by oil spills and offshore oil drilling. The Federal Government has authority to conduct water clean-up operations and bill the responsible party later.

Coal

What Is Coal?

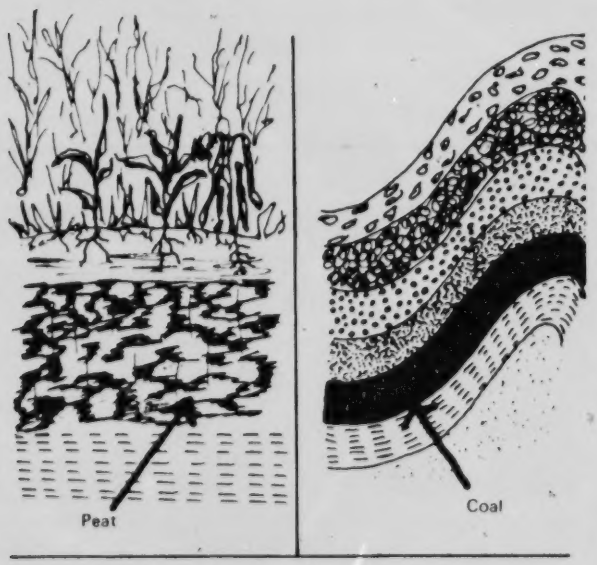
Coal, like oil and natural gas, is a fossil fuel formed from the remains of vegetation. Half a billion years ago, the earth was warmer and wetter than it is now. Fern trees, huge mosses, and other tropical plants grew profusely in earth's swampy surface. They died and fell into the shallow water, building up layer upon layer. Cut off from oxygen by the water, much of the plant matter remained undecayed. As time passed this undecaved organic matter built up into the spongy substance we call peat (see Diagram 1). Dirt and sand washed down from the mountains and gradually buried the peat deeper and deeper. As the pressure compacted it and the heat increased much of the gaseous part, the hydrogen and oxygen were driven off and almost pure carbon was left behind — the hard, shiny black mineral we call coal. Now found in *coal beds*, seams usually 3 to 8 feet deep (although seams up to 100-feet thick are known), twisted by the folding of the earth's crust, coal is sandwiched between layers of shale, sandstone, or other kinds of rock as shown in Diagram 1.

Mining Coal

Coal is mined either on the surface or underground. In underground mining, a hole is dug to the coal bed and gradually a tunnel large enough for men and machines to enter is cleared. Miners then begin the task of drilling and removing the coal. Coal is cut from the seams with automatic equipment. Shuttle cars or conveyor belts carry the coal to the surface, where it is processed and loaded on trucks or directly on railroad cars and sent to its destination. About half of all the coal produced in the United States is mined underground.

Surface mining, or *strip* mining as it is called, is used when the coal is located near the surface. Large power shovels and bulldozers remove the earth, rock, and vegetation above the coal seam, sometimes to a depth of 100 feet. Then smaller power shovels are used to remove the coal. Strip mining has become more important during the past decade and now about half of all domestic coal is produced in this way.

DIAGRAM 1



Coal as Heat Energy

When coal is burned, the sun's energy that was stored in the plants hundreds of millions of years ago is released. Coal was once an important source of home heat, but now only a few coal-burning heating systems remain and most of these are in large buildings. When it is used to heat a building, the furnace system is similar to the one shown for oil; heat can be transported around the building by hot air, hot water, or steam.

The more important use of coal for heat is indirect. About half (46 percent in 1973) of the electricity we use is generated at coal-burning utility plants. This electricity can then be used to heat or cool houses and commercial buildings.

How Much Coal Is Available?

In 1974 coal accounted for only 18 percent of our total energy. We produced about 600 million tons of this fuel and exported 54 million tons to foreign countries. Since coal is our most abundant fossil fuel resource, its use is expected to increase; some experts predict that we will mine almost a billion tons of coal per year by 1980. It is thus important to know how much coal we have.

Coal deposits are much easier to find and map than are deposits of oil and natural gas. They are nearer the surface and are usually found where the geologists predict that they should be. The total coal which can be mined from known seams is given as 390 billion tons.* This is coal that is economically feasible to mine and counts only that 50 percent which will be extracted. (Present techniques leave about half the coal in the ground.) If we use coal at the rate we did in 1974, these reserves will last about 650 years. If our use increases 5 percent per year (this means our consumption will double every 14 years), the coal reserves will only last 70 years—not even coal can last forever.

How Much Does It Cost To Heat with Coal?

As we said earlier, coal is no longer used to any great extent in home furnaces. Still, some idea of the cost is helpful and is given in the table below, using 1974 coal prices in Washington, D.C. On the average it would cost $244 per year to heat a home by coal.

The cost of coal will no doubt rise. Not only are labor, machinery, and other production costs rising, but environmental and miner health costs must also be added. Mine safety is being improved, payments to miners with

*Estimates differ from source to source. These estimates come from Chapter 2, Volume II, of the NSTA *Energy-Environment Source Book*.

"black lung" (a respiratory disease caused by inhaling coal dust) are now being made by coal companies, and stricter land reclamation laws may add several thousand dollars per acre to production costs. All these increases, however, will add only a dollar or so to the price of a ton of coal, and it will probably remain our cheapest fossil fuel.

What Are the Environmental Effects of Producing and Consuming Coal?

Coal mining is harmful to the environment in a number of ways. When strip or surface mining is used, huge shovels — 200 feet tall, weighing millions of pounds — and other equipment move trees, shrubs, grass, and topsoil to get at the coal underneath. This is a cheaper way to harvest coal than underground mining and usually yields a higher percentage of the coal in the seam, 80 to 90 percent, than the 50 percent yield from underground mining.

Strip mining leaves the ground turned up and desolate. The exposed, bare ground, if it is on a hillside, is easily eroded and the silt and acid (formed when water combines with sulfur impurities) damage vegetation and stream life. On arid land it may take years for any vegetation at all to return.

The strip-mining picture is improving in this country. All states now have laws that require the restoration of mined lands, and the enforcement of these laws is becoming more vigorous.

Coal mining has also been costly in terms of human life. It is considered the most hazardous occupation in this country, 152 miners were killed in 1973. New coal mine health and safety regulations are being enforced, making the mines safer. The 152 miners killed in 1973 was a much better record than the 250 killed in 1970.

In addition to the mine accidents, many miners have been afflicted with black lung disease. It is estimated that as many as 125,000 miners may have this life-shortening illness and that it contributes to some 3,000 to 4,000 deaths per year. The new health and safety laws call for regulation in this area and measurement of dust levels in mines already show that coal dust is below the designated maximum level.

Coal also causes problems when it is burned. Most coal contains a chemical called sulfur that, when it is burned, creates a gas which escapes up the smokestack and contributes to the smog we sometimes see over cities in the winter. This smog can be harmful to people and other living things. And soot from burning coal is one of the causes of the dirt and grime that cover our cities. The new clean air laws cause utility companies to employ emission control devices. Most electric power plants now have equipment that removes 99 percent of the soot from the smokestack fumes and equipment is coming into use that can take out most of the sulfur also.

Since our supplies of coal are much greater than the supplies of the other fossil fuels, oil and natural gas, scientists and engineers have developed means for creating synthetic or manufactured gas from coal. While the environmental effects of mining coal would not be reduced, the "gasification" of coal could add to our supplies of natural gas and decrease the contribution coal makes to our air pollution.

Regional Costs of Heating with Coal

Region	Amount (in Million British Thermal Units)	Cost
New England	89	$175
Middle Atlantic	104	204
East North Central	164	322
West North Central	154	302
South Atlantic	102	201
East South Central	112	219
West South Central	101	198
Mountain	138	271
Pacific	111	218

Figures based on $51 per ton, 1974 price, Washington, D.C.

1 ton coal = 26 M BTUs

Electricity

What is Electricity?

We call electricity an intermediate form of energy. It is not stored energy, such as the fossil fuels or uranium, and it is not in the form in which it finally appears as work or heat. Stored, or potential, energy is converted to electric energy by the processes described below. Electric energy then must be converted by a motor or a heater in order to be used.

Electric energy comes out of the following processes:

1) A fuel such as coal, oil, or natural gas is burned and heat energy is released. (Nuclear energy is also converted to heat energy.)
2) Heat energy is used to produce very hot steam.
3) The steam turns a steam turbine, converting heat energy to mechanical energy.
4) The turbine turns an electric generator, converting mechanical energy to electric energy.
5) Electric energy is transformed to very high voltages in a transformer and transmitted to substations and around the country on high-voltage transmission lines.
6) From the substations, the electric energy is transformed to appropriate low voltages and distributed by wire to offices, industrial plants, homes, and the like, where it is converted to heat, light, or mechanical energy by a variety of electrical devices.

The entire process is shown schematically in Diagram 1, below.

Electric power for heating and cooling: Homes are wired to carry electric current throughout the house. This electric power can then be used to heat and cool the home, to power appliances such as washers, dryers, TVs, and toasters, or to provide light. To heat a home electrically, baseboard heaters containing electric coils can be placed in each room, or larger space heaters can be used to heat a room (see Diagram 2). To cool a home, a centrally-located air-conditioner can be used to circulate cool air through air ducts or individual air-conditioning units can be placed in various windows to cool rooms.

How Much Electric Power is Available?

The amount of electric power that can be produced depends upon two factors: available fuels and available generators. In 1973, 81 percent of our electric power was produced by burning fossil fuels (see Graph 1). This poses a problem. Our domestic supply of natural gas and oil is diminishing and imports of these fuels are becoming more expensive. The estimated lifetimes of our various fossil fuels is summarized in Table 1. This

TABLE 1
Predicted Lifetimes of Fossil Fuels[a]

Coal	650 years
Oil[b]	180 years
Natural Gas	110 years

(a) Lifetime calculations assume consumption continues at 1973 rate and are based on "ultimately recoverable resources" rather than known "reserves."

(b) Based on continued importing of 45 percent of oil consumed. If only domestic oil is consumed, the lifetime would be 80 years.

DIAGRAM 1

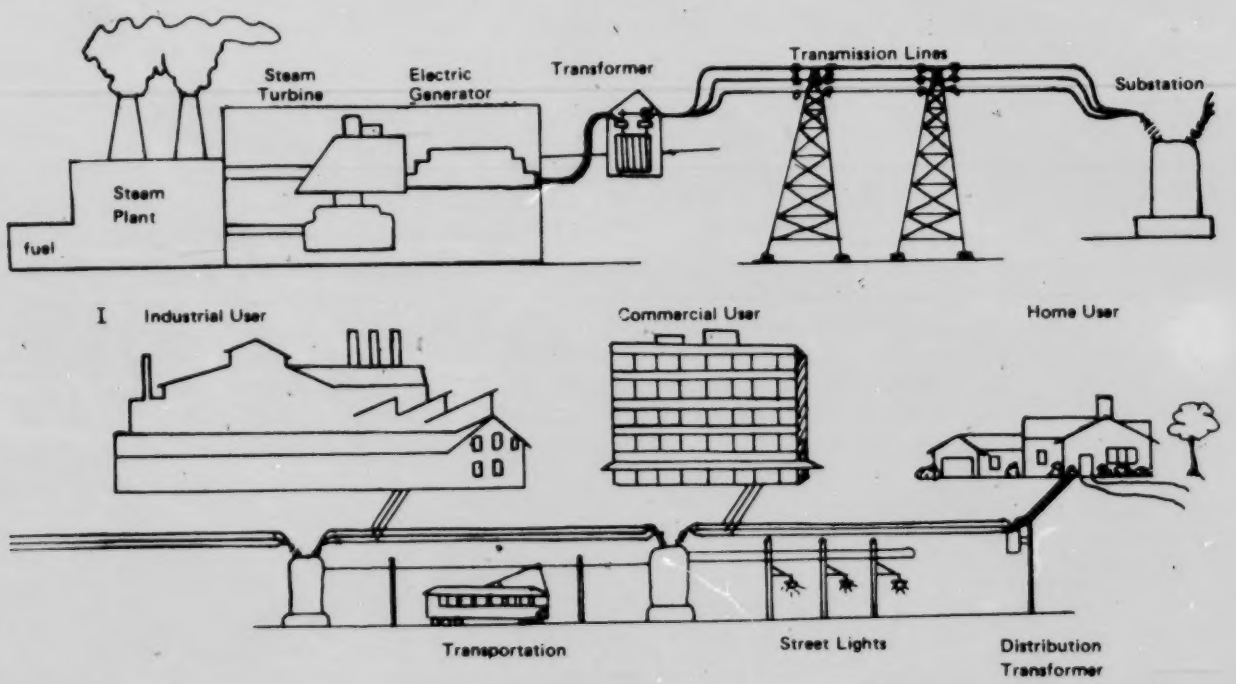


table tells us how long they will last *if each year we use the amount we used in 1973*. Since we are actually using them faster than this, they will probably not last this long. The Federal Power Commission predicts that nuclear power will be providing 40 percent of all electric energy by 1990. In addition, methods of converting solar energy into electric power are being investigated. Only coal can be considered a possible long-range energy resource, and increased use of coal will reduce the supply more quickly than we presently prodict.

In addition to the need for an adequate fuel supply, electric energy is limited by the number of power plants which can generate electricity. There are presently about 3,000 power plants in the United States. A generator consists of many coils of wire placed between the north and south poles of a magnet. Steam moves the turbine, which spins the coils of wire and causes electric current to flow. It requires four to seven years to build a typical large generating plant. Each generator has a peak capacity (upper limit) for producing electric power. In 1974 the total generating capacity of all electric plants was about 500,000 megawatts* of electric power. By 1990 this figure is expected to be 1,260,000 megawatts — almost three times as much. Modern generator capacity ranges from 1,000 to 3,000 megawatts. (A 3,000-megawatt generator could power Washington, D.C.) We will need at least another 300 generating plants by 1990.

What Does Electric Energy Cost?

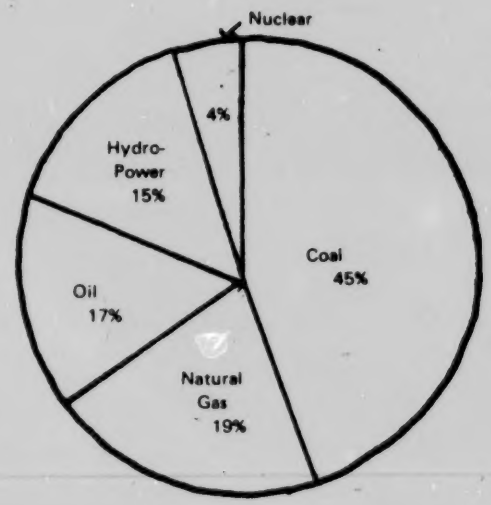
Electric energy use has grown because the price for electricity has actually decreased over the years. In 1940 the average electric energy cost was 2.2 cents per kilowatt-hour. (A kilowatt-hour can power a 100-watt lightbulb for 10 hours.) In 1968 it cost, on the average, 1.5 cents per kilowatt-hour. Since 1971, however, the price of electricity has been increasing. The average cost of heating an electrically-powered home in 1972 was estimated to be between $500 and $600 for the year (see Table 2).

The cost of building an average electric power plant is now more than $500 million. Many experts believe that the days of declining costs are over. As fossil fuel costs rise, electricity costs are also likely to rise. We can expect electric power to be available if we are willing to pay the price for it.

What Are the Environmental Effects of Producing and Consuming Electricity?

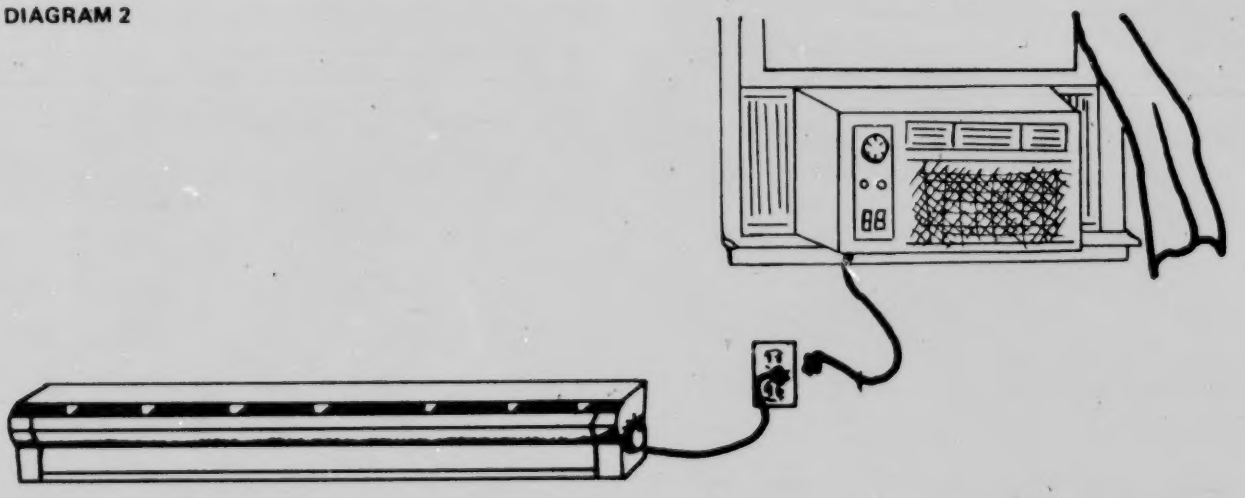
Electric energy today depends largely upon the fossil fuels — coal, oil, and gas. Whenever a fuel is burned to create the steam which produces electricity, much of the heat created by burning the fuel is lost. The best electric

GRAPH 1
Fuels Which Produce Electric Power



*A watt is a measure of electric power; i.e., the rate at which electric energy is produced. A megawatt is one million watts. For reference, a typical football or baseball stadium uses about a megawatt of electric power for night lighting.

DIAGRAM 2



plants convert 40 percent of the fuel's energy into electric energy, allowing 60 percent to become wasted heat. About 10 percent of this heat loss leaves the plant as hot gas while the rest is discharged into the cooling water and enters nearby rivers or lakes. This increase in water temperature does not directly affect the health of people, but it can affect the marine life in the body of water it enters. Some of these effects are considered beneficial for the marine life, but most are considered harmful. At a certain stage of development, an increase in water temperature can help eggs and young fish grow faster. However, increased temperature often results in a loss of the more desirable species of fish and stimulates the less desirable. Higher temperatures can also affect the migratory habits of fish.

In addition, higher temperatures increase water evaporation and help concentrate the minerals already present in water. In cold areas, the warmer waters would stimulate recreational use; while in already warm waters, they would make the waters' use undesirable.

The Water Quality Act sets the standards for water quality. This includes temperature regulation of our rivers, streams, and lakes. Each state specifies the allowable rate-of-change of water temperature. Most states set the maximum water temperature change at less than 5°F.

Utilities are seeking practical ways of using their waste heat for such things as heating commercial buildings or in industrial processes. It may also be employed in desalting water and in agriculture. They are also turning away from direct use of river or lake water to cooling towers. In these towers a smaller amount of cooling water is recirculated and cooled either by evaporation (the "wet cooling towers") or by cooling fins in contact with air (the "dry cooling towers"). The use of such towers might increase the cost of electric power 5 to 10 percent.

Besides increasing water temperatures, power plants burning fossil fuels add sulfur dioxide and other gases to the air, forming smog that is harmful to man, materials, and crops. It contributes to diseases such as bronchitis and emphysema. The Clean Air Act establishes and maintains regional, state, and local air pollution control programs and enforcement of its provisions is bringing about more control over utility emissions.

In addition to gases and heat, fly ash enters the air and deposits dirt on surrounding homes and factories. This can also affect health and possibly even the climate of a given region. Gases and fly ash are controlled by equipment capable of removing 99 percent of the particles from the air.

In transmitting electricity from generating stations to local customers, towers, utility poles, and miles of cable are needed. High-voltage transmission lines require 200-foot-wide rights-of-way and now occupy about four million acres in the United States. Lesser effects include above-ground interference with radio and TV reception and underground electric currents which may corrode sewer and water pipes.

In addition to the environmental problems caused by creating electricity itself, the effects produced by obtaining the fossil or other fuels for its generation must also be considered.

Electric power does, however, make many positive contributions to our society. It creates jobs for the people who extract and transport the fossil fuels, as well as other jobs in the power plant and along the transmission lines. It provides the power for industry, for most of our home appliances, and for most of our forms of entertainment — radio, TV, and movies, for instance. Electric power is largely responsible for the high standard of living and many of the luxuries we enjoy today.

TABLE 2
Regional Cost of Electric Power for Home Heating

Region	Amount (in Million British Thermal Units)	Cost*
New England	89	$731
Middle Atlantic	104	656
East North Central	164	769
West North Central	154	589
South Atlantic	102	511
East South Central	112	432
West South Central	101	330
Mountain	138	539
Pacific	111	420

Source: Potomac Electric Power Company, Washington, D.C., 1974.

* $5.00 per 1,000,000 BTU.

Nuclear Energy

What Is Nuclear Energy?

Many people believe that nuclear energy is the answer to our energy problems. Others feel that it is a threat to public safety. It has already begun to play a large role in our energy future.

Nuclear energy is created by a process called fission. In fission the atoms of Uranium 235 are bombarded inside a nuclear reactor by neutrons (see Diagram 1). This bombardment results in the splitting of the uranium atom into two smaller atoms. When the uranium splits, heat is released along with more neutrons to continue the process. Since nuclear reactors are very complex and require many safety precautions, they can not be used as direct sources of heat for individual homes. The heat produced in a large reactor, however, can be used to heat water which creates steam and generates electric power. In 1974 nuclear-electric power accounted for about 6 percent of our total electric power. The Federal Power Commission predicts that by 1990, 40 percent of all electricity will be powered by nuclear energy.

Nuclear reactors: The nuclear reactor provides the environment in which fission occurs and is controlled. It also recovers the heat that is used to produce the electricity. The major parts (see Diagram 2) of the reactor are:

- ☐ fuel, which is used in the fission reaction and produces the energy
- ☐ control elements, which set the rate of energy released
- ☐ cooling fluid, which removes the heat generated in the reactors

The nuclear plant: Today there are 50 licensed nuclear plants located in 26 states. The average plant costs $600 million to construct, requires 4 to 6 years to build, and produces 1,000 megawatts* of electric power. The plant design is determined by the kind of nuclear reactor used (see Diagram 3). Besides uranium, one of the important resources necessary for a nuclear plant is water. It is estimated that 330,000 gallons of water flow through a reactor *per minute*. A nuclear plant functions much like a fossil fuel electric plant. Both use steam to drive a turbine generator that produces electricity. The main difference is the way the steam is produced. In fossil fuel plants, coal, oil, or gas is burned to boil water to make steam. In nuclear power plants, nuclear fission produces heat which creates the steam.

Home use: Nuclear energy can be used indirectly to heat and cool homes. It is first used to produce electric energy, and then this electric power is sent to homes. In the home, electric baseboard heat or space heaters are used to provide heat, and electrically powered air-conditioners can be used for cooling the home.

*A watt is a measure of electric power: the rate at which electric energy is produced. A megawatt is one million watts. For reference, a typical football or baseball stadium uses about a megawatt of electric power for night lighting.

DIAGRAM 1

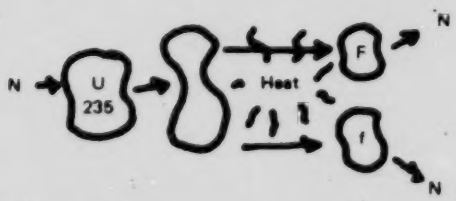


DIAGRAM 2

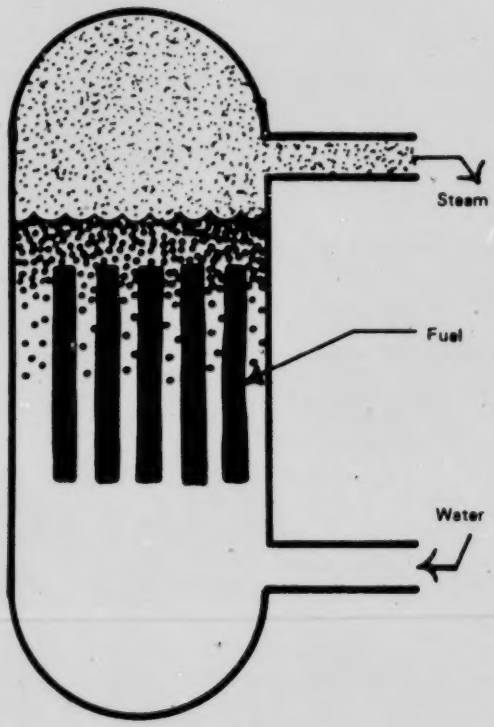
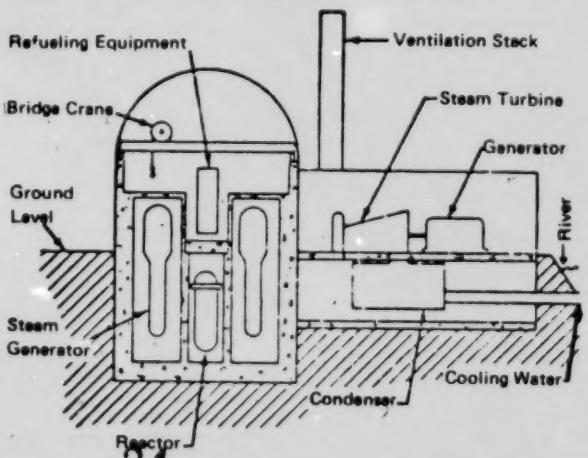


DIAGRAM 3



How Much Nuclear Energy Is Available?

The basic fuel for nuclear energy is uranium, a somewhat rare mineral. As with other fuels, the amount of uranium available depends to a large extent on the price we are willing to pay for it (see Table 1). It is estimated that a typical nuclear power plant uses 130 tons of uranium to produce 1,000 megawatts of electricity. (A 1,000-megawatt plant could power one-third of the city of Washington, D.C.) The 50 plants in operation today produce 33,000 megawatts of electricity and use approximately 4,290 tons of uranium per year. At this rate, using the $10-estimate figures from Table 1, the lifespan of our domestic uranium reserves would be about 220 years. Since we are using more and more each year, they will not last that long. In fact, if the growth of nuclear-generated electricity were to continue at its present rate, the consumption of electricity doubling every three years, the supply of under-$10-per-ton uranium would only last about 30 years.

Scientists are working on a new reactor known as the breeder reactor. Breeder reactors are so named because they are able to produce a by-product, plutonium, which is itself a fuel. It is estimated that the breeder reactor can increase the lifetime and supply of nuclear fuels fifty-fold. Although breeder reactors are not being used today, they are likely to be developed and used in the near future.

How Much Does Nuclear Energy Cost?

Today the cost of producing electricity using nuclear power is similar to fossil fuel costs. The cost of heating and cooling with nuclear-electric power depends upon the size of the house, its geographic location, and the price of uranium. The average annual cost of nuclear-electric power to heat a home is about $550 to $600 (see Table 2 for regional costs).

How Does Nuclear Energy Affect the Environment?

Nuclear energy affects the environment in two main ways. On the one hand, there are environmental effects of mining and processing uranium. On the other hand, there are dangers to the environment and to people from the reactors themselves.

Effects of mining uranium: Uranium mining problems are similar to those of other types of mining. The miners are exposed to dust, accidents, fumes, and intense noise. The major concern, however, is the added presence of radioactive gas. Uranium is slightly radioactive and the U.S. Public Health Service has connected the relationship between exposure to radioactivity and lung cancer in humans. Uranium miners have higher rates of lung cancer than the general population. Controls for reducing the amount of radioactivity in the mines are being investigated. The waste materials from uranium mining are also dangerous and must be kept out of contact with living things.

Effects of nuclear reactors: There are two dangers from the reactors themselves. The leftover fuel material is highly radioactive and must be kept out of contact with living materials. There are about 45,000 gallons of radioactive waste produced for every 1,000 megawatts of electricity produced, and this must be stored somewhere for hundreds of years.

Large doses of radiation can seriously injure or kill human beings. Much less is known about the effects of the very small doses associated with the discharge from nuclear plants. Scientific opinion is, however, that even small doses do some amount of genetic damage and carry a low cancer-causing probability. Radiation levels from nuclear plant discharge are considerably smaller, at present, than are the levels we are exposed to from other man-made and natural sources.

The radioactivity associated with nuclear waste is potentially much more dangerous than that from plant discharge and for that reason it must be safely and securely stored. The final disposition of this material has not yet been decided, and more and more accumulates as the number of operating reactors increases.

The major concern about nuclear reactors is the possibility of an accident. While present-day reactors cannot explode like a nuclear bomb, there are possible malfunctions that can result in a small explosion. The spread of radioactive debris over the countryside would be a catastrophe.

In a recent study funded by the Atomic Energy Commission (this agency no longer exists and most of its functions are absorbed in the Energy Research and Development Agency, ERDA), the probabilities of such accidents were estimated. The conclusion was that

TABLE 1
U.S. Uranium Resources

Price Per Pound	Reasonably Assured Reserves (in tons)	Estimated Additional Resources (in tons)	Total (in tons)
$ 8.00	277,000	450,000	727,000
10.00	340,000	700,000	1,040,000
15.00	520,000	1,000,000	1,520,000

Atomic Energy Commission, 1974

TABLE 2
Regional Costs of Nuclear-Electric Energy

Region	Heating Cost
New England	$409
Middle Atlantic	476
East North Central	751
West North Central	705
South Atlantic	469
East South Central	511
West South Central	462
Mountain	632
Pacific	510
Average	$569

(Based on 1973 figures, 1,000 megawatt nuclear power plant—light water reactor, $4.57 per 1,000,000 BTUs.)

serious accidents are not very likely — only one chance in one billion of an accident causing some 2,000 deaths. Such an accident, however, could do as much as $2 billion in property damage. These are risks which must be weighed into the cost of nuclear power.

Solar Energy

What Is Solar Energy?

Solar energy, sunlight or radiant energy, falls on the earth, providing both heat and light for plant and animal life. Scientists and engineers are just beginning to find practical ways to use solar energy to heat and cool individual homes. The United States Government is sponsoring several experimental projects which are investigating methods of collecting solar energy and converting it to electric energy. This solar-electric energy could then be used to heat and light entire communities.

Solar energy as a heat source: The present method of using solar energy to heat a home requires some type of collector which absorbs and traps the sun's energy. One side of the roof of a house might be converted into a solar collector similar to a very large "glass sandwich" (see Diagram 1). The "sandwich" has an outside layer of glass, a half-inch air space, a second layer of glass, and a layer of aluminum painted black. The glass allows the sunlight to pass through to the black surface, which absorbs the light and is heated. This absorbed energy then heats water which flows over the black surface or flows through pipes directly behind the black surface. This hot water can then be piped to hot water radiators throughout the house or it can be used to heat air which is circulated through ducts throughout the house.

Using solar energy: A solar heating and cooling system is expensive to install now, but the rising costs of other fuels make solar energy one of our best hopes for the future.

A solar-heated home: Harry Thomason of Washington, D.C. has designed a workable solar heating system for an individual home (see Diagram 2). He made a solar collector by covering one side of the roof of his house with two layers of glass followed by a third layer of corrugated (∩∩∩) aluminum. He placed a 1,600-gallon water tank in his basement. This tank is insulated and surrounded on three sides by fist-sized stones. Pipes lead from the tank, across the basement, up the side of the house to the top of the roof. Water moving through a pipe trickles down the hot corrugated aluminum and becomes warm. This warm water flows into the tank, heats the surrounding stones which in turn heat the air. This warm air is then circulated by a fan throughout the house.

Mr. Thomason's storage system can provide heat for five sunless days. Average daytime temperature in the house is 72°F and the nighttime average is 68°F. A small furnace is kept in the basement for use during prolonged sunless periods. With certain changes this system can also be used to cool a house.

How Much Solar Energy Is Available?

Solar energy is the most abundant and continuous form of energy available to man. Much of the sunlight that approaches earth is reflected by the atmosphere back into space. It is estimated that only half of the solar energy from the sun actually reaches the ground. This is still a great amount of energy — roughly 810 kilowatts per acre. Only a small part of this is actually used by man. Sunlight not only provides light and heat but is indirectly the source of our food, winds, water power, and the fossil fuels. When scientists learn to successfully collect, store, and transport solar energy, they will have tapped the greatest energy source available to us.

What Does It Cost?

Solar heating and cooling systems are expensive to install but very inexpensive to operate. The Thomason system costs about $2,500 to install but only $6.30 a year to use. Local governments (the Washington area is one) and private companies are sponsoring research projects in hopes of finding less expensive systems for using solar energy. There are also research teams investigating practical methods for converting solar

DIAGRAM 1

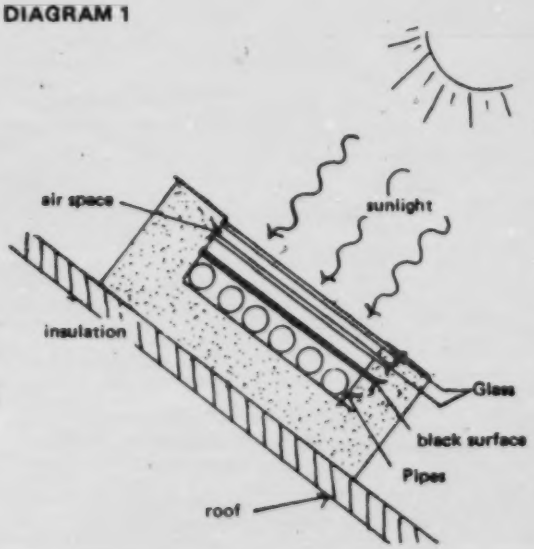
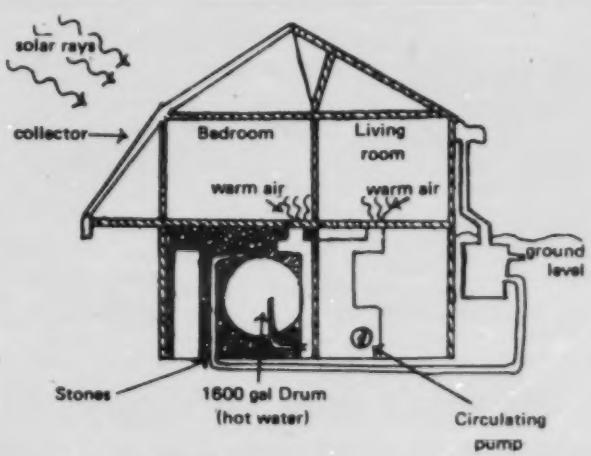


DIAGRAM 2



energy into electric energy which can be used to power entire communities.

The basic cost of operating a solar-heated home will vary according to the size of the house and the general climate of the region in which it is located. Colder regions would require greater use of the auxiliary heating system to maintain a 70-72°F house temperature.

What Are the Effects on the Environment?

Solar heating and cooling have no known harmful effects on man or plant life. If used in an individual home, the system can provide a clean form of heat without adding pollution to the surrounding air, land, or water. In order for solar heating to be widely used, however, we will need to find a way to make electric energy from solar energy. At our present level of technology, large tracts of land would be needed for solar collectors. Two physicists, Drs. Aden Meinel and Marjorie Meinel, have designed a model of a solar "farm" which could be used to collect solar energy and convert it into electric energy (see Diagram 3). They estimate that these solar farms would require 10,000 square miles of land to produce enough electricity for the entire United States. This would mean that about 25 square miles of land, or an area roughly equal to 1,000 football fields, would be needed to power Washington, D.C. (based on the 3,000-megawatt* 1970 consumption rate).

If cheaper, more compact systems can be designed, solar energy is likely to be an increasingly popular form of energy in the future. It is probably one of the best alternatives to the long-term energy problem, but we are just beginning to understand its potential.

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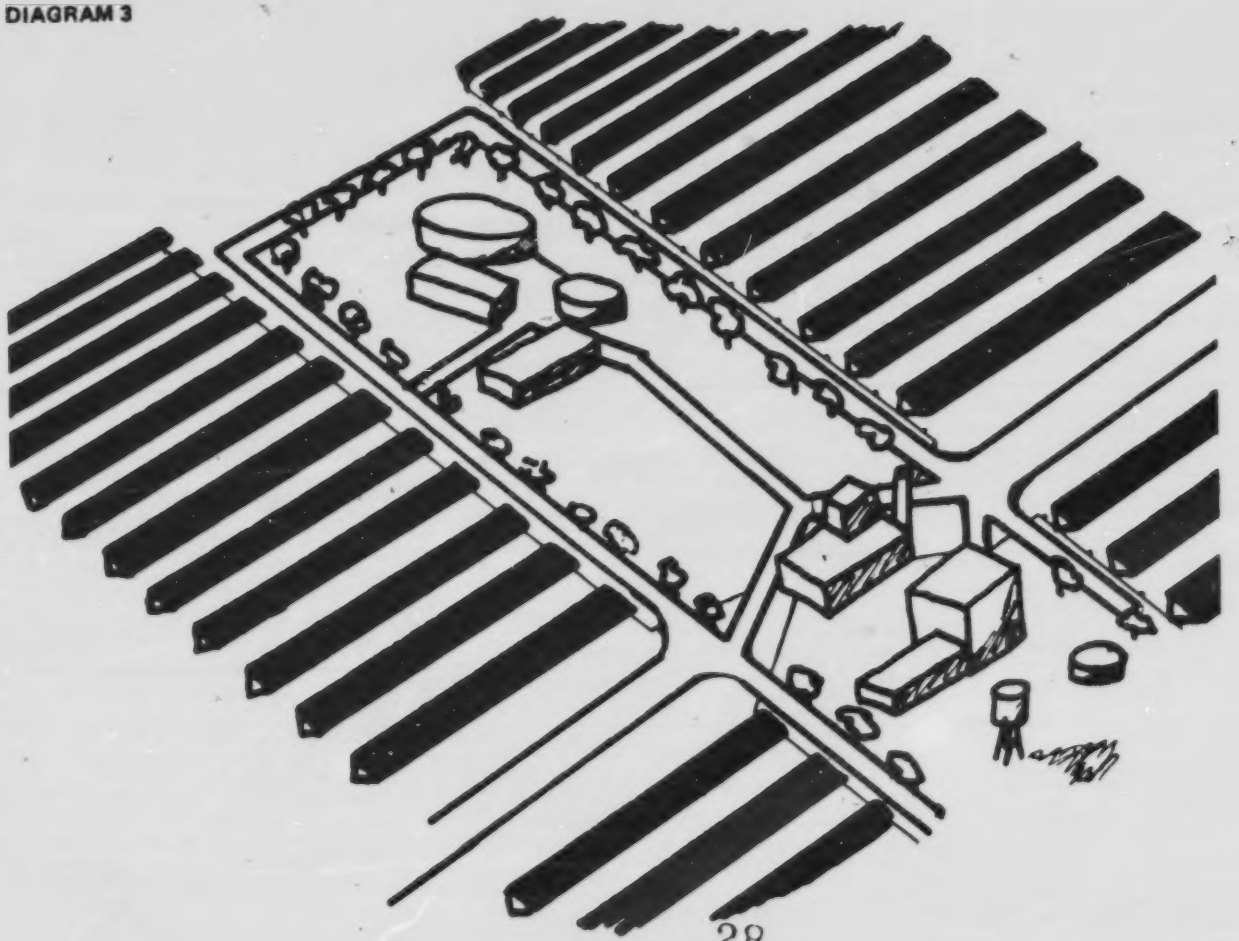
*A watt is a measure of electric power: the rate at which electric energy is produced. A megawatt is one million watts. For reference, a typical football or baseball stadium uses about a megawatt of electric power for night lighting.

DIAGRAM 3



Geothermal Energy

What Is Geothermal Energy?

Geothermal energy is created by the natural heat of the earth. When the heat from the molten inner core of the earth meets the underground water, hot water or steam results. When this water or steam pushes through the surface of the earth, it creates either a hot water spring or a geyser (see Diagram 1).

People have used hot water springs as health baths for centuries, but only in the 1900s have natural steam and hot water been used for heating homes. In 1904 geothermal energy was first used in Italy to provide electricity. Hungary and Iceland started piping natural steam and hot water directly into homes in the 1930s. Finally, by the 1960s, New Zealand, Japan, and the United States started to build small power plants that used geothermal steam to generate electricity. Presently geothermal energy accounts for 0.1 percent of the world's electric power. The largest United States field, California's The Geysers, provides about 500 megawatts* of electric power.

Tapping and Using Geothermal Energy

Geysers indicate that in the surrounding area hot underground water and steam are near the earth's surface. Once the geysers have been located, a geologist, a scientist who studies the earth and its outer layer, investigates the size, volume, and temperature of the geothermal system. If conditions are favorable, a well is dug near a geyser and the steam is channeled through large pipes to its destination (see Diagram 2). This natural steam may be piped directly to homes or to a nearby electric plant.

When natural steam is piped directly to a home, it fills hot water radiators and provides heat. More often today it is piped to an electric plant and is used directly to turn the turbines and generate electric power. Then this electric power is transmitted through wires into individual homes. Inside a home, electric power can heat either by using an electric hot-air furnace or by using electric space heaters. Electric power can cool by using individual air-conditioners or a centrally located forced cool air system.

How Much Geothermal Energy Is There?

At the present time geothermal energy provides 0.1 percent of our electric power and only isolated examples of direct steam power for homes. It is limited to those areas where geysers exist. In the United States, most of these areas are located in the Western states. Geothermal springs are located in Idaho, Nevada, Colorado, New Mexico, Oregon, Wyoming, Utah, and Montana (see map of Geothermal Regions). The more

*A watt is a measure of electric power: the rate at which electric energy is produced. A megawatt is one million watts. For reference, a typical football or baseball stadium uses about a megawatt of electric power for night lighting.

DIAGRAM 1

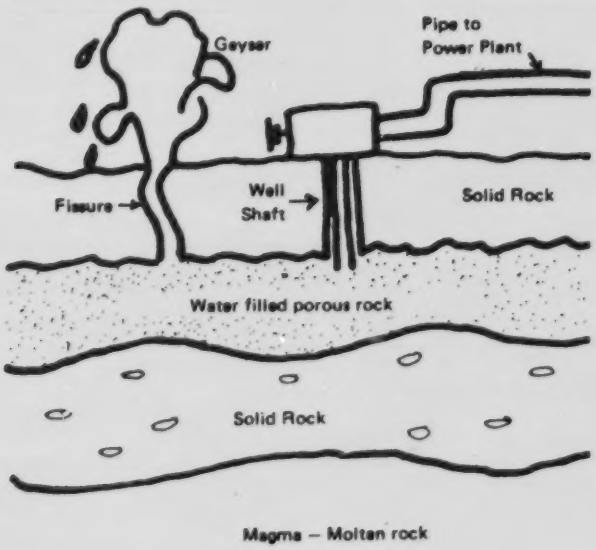
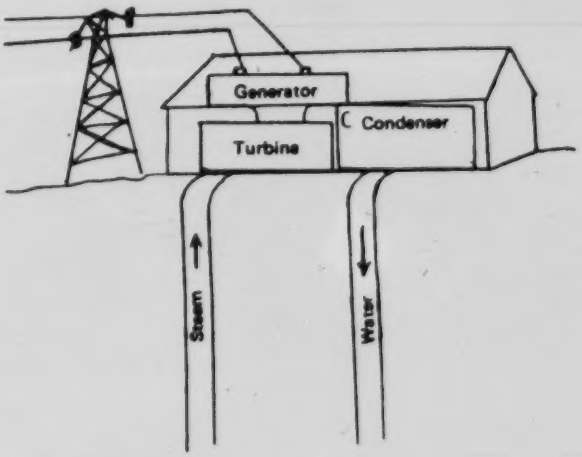


DIAGRAM 2



Map of Geothermal Regions

thorough survey now under way will, no doubt, locate many more sources not visible on the land's surface.

Steam is not easily transported long distances, therefore, geothermal-electric power plants are located on the geothermal sites. Relatively small, they service only the local area. The Geysers Plant in California provides half of San Francisco's electricity.

How Much Does It Cost?

One of the most attractive qualities of geothermal energy is its low cost. The initial costs of locating reservoirs of natural steam are fairly expensive, but natural steam itself is very inexpensive when compared to nuclear and fossil fuels. Natural dry steam (steam without any water droplets) is available at about $0.70 per million British Thermal Units (BTU)*. If steam is piped directly to individual homes, the average cost of heating with dry natural steam would be about $92 per year.

When dry natural steam is used to create electric power, it is also less expensive than nuclear or fossil fuels. An estimated cost for geothermal electric heat for the average American home would be about $200 per year (see Table, Regional Cost of Geothermal Electric Energy).

This is about one-third the cost of oil-generated electric heat and one-half the cost of nuclear-electric heat. So the relatively low cost of geothermal-electric heat makes it a desirable alternative for heating and cooling homes where it is available.

How Does It Affect Our Environment?

The use of geothermal energy can have adverse effects on the surrounding land area and on the people and animals who live there. Most geysers and hot water springs are present in scenic areas with unique landscapes. Yellowstone National Park is one area where geysers, such as Old Faithful, are located. People often object to "spoiling" these landscapes with geothermal wells. Tapping geothermal energy would require the construction of roads, ponds, wells, large above-ground pipes, and an electric power plant. In addition, geothermal wells require a ventilating system to prevent the loss of the well due to condensation. Noise from an unmuffled well has been compared to a jet plane on takeoff. When the steam and fluids of a geothermal reservoir are removed, the ground may subside, or sink, a little. In residential areas this would create problems. One solution to this is to pump the used water and fluids back into the earth after they have been used.

Geothermal energy also affects the water and air. Poisonous or highly salty geothermal fluids can pollute streams, ponds, and ground water. In addition, the heat added to the water can be fatal to marine life. Certain gases, such as ammonia and carbon dioxide, which are released from the wells, can cause serious air pollution in the local areas. These pollutants will have to be controlled at the well.

Although people, wildlife, and marine life are affected in various ways by geothermal energy, it does not create as many problems as fossil and nuclear fuels. Geothermal energy can be used directly and does not require processing plants for fuels. It does not require major land disturbances, such as mining, when extracting the fuel. It also does not create as many problems with waste disposal as do the fossil fuels. It produces a basically clean heat. For these reasons it is considered a desirable source of energy where it is available.

*1 BTU = one-fourth of a Calorie.

Regional Cost of Geothermal Generated Electric Energy (Estimated)

Region	Regional Use (in Million British Thermal Units)	Regional Cost
New England	89	$138
Middle Atlantic	104	162
East North Central	164	254
West North Central	154	239
South Atlantic	102	158
East South Central	112	174
West South Central	101	157
Mountain	138	214
Pacific	111	172

Source: Bureau of Mines, U.S. Department of the Interior, 1974.

ACTIVITIES

Energy Activity No. 1

Title: "Snow on the Roof Top"

Concept: Energy costs are partly related to the efficiency of energy conversion.

Objective: The student will recognize those homes that appear to be insulated and give public recognition and thanks.

Subject Area: Social Studies, Science, Language Arts

Level: K-3 4-6

Time involved: Variable

Materials needed: Examples of kinds and grades of insulation, adult volunteers to assist on field trip

Procedure:

1. Direct the activity by discussing the following questions: What is the purpose of insulation? What are some kinds of insulation (from pot holders to wood)? What are some kinds of insulation used in the construction of homes? What are they made of? Where are they found? How can we tell if a house attic is insulated or not?

2. At this point, bring out the fact that if heat rises and there is no insulation to stop it from going out the roof. After a snowy day, what would snow on a roof indicate? (If the weather permits, step outside the school to look for indications.) Note the effect of the sun melting so look for snow on all sides.

3. Lead the students to ways of recognizing people for their wise judgment in energy conservation by insulating their homes. What are some ways of thanking these people? (Letters, certificates, etc.)

4. The students then will draft a letter or a certificate that will be delivered by them in large groups in the neighborhood. Include in it

such things as:

a. It appears from the snow on your roof that you have some insulation in your house, etc.
b. The suggested regulation for our town is . . .
c. It takes everyone's help to conserve energy and your help is evident and appreciated.
d. We are learning the importance of saving our depleating energy sources, etc.

NOTE: The letter should inform the parents of the purpose of the project. It should be positive in nature and as personal as possible yet not too long.

5. After many letters are complete, take a walk in the neighborhood to deliver to apparent insulation users. They may be put in door handles or between storm doors (not in mail boxes).

RELATED CAREER ACTIVITIES:

Invite builders and designers in to show and discuss ways to conserve energy.

Energy Activity No. 2

Title: "What Could You Do Without?"

Concept: Limitations may be viewed as relative to changing energy demands.

Objective: Given the opportunity, the student will identify at least two energy-consumptive devices that he/she might choose to eliminate.

Subject Area: Language Arts, Career Awareness

Level: 1-2

Time involved: 2 - 30 minute sessions

Materials needed: Drawing or writing paper, book - Andrew Henry's Meadow, Doris Burns, Coward-McCann, Inc. Published 1965.

Procedure:

1. Read Andrew Henry's Meadow, which tells the story of a boy who likes to invent things but gets in trouble with his family. He moves away to a meadow, where he builds a house to fit his special needs. Gradually, many children follow and have houses built according to their needs.

2. The book serves as a basis for a discussion of what student's houses would look like if they could build them.
   a. Discuss whether students could really live in houses like those in the book.
   b. Discuss what would really be needed in a house in order to live in it year-round.
   c. Discuss which machines and appliances might not be needed or which the students would be willing to do without.

3. Students will write about or draw pictures of at least two machines or appliances that they might do without.
   a. Bring into discussion, if the machines are working less, who will be working more?

Energy Activity No. 2
(continued)

SUGGESTED CAREER AWARENESS ACTIVITY:

Invite a builder to speak to the class about his/her job. List jobs involved in building a house.

Energy Activity No. 3

Title: "Pinwheel Parade"

Concept: Moving air is a form of potential energy.

Objective: The child will understand moving air can do work.

Subject Area: Language Arts, Art, Science

Level: K-3

Time Involved: 30 minutes

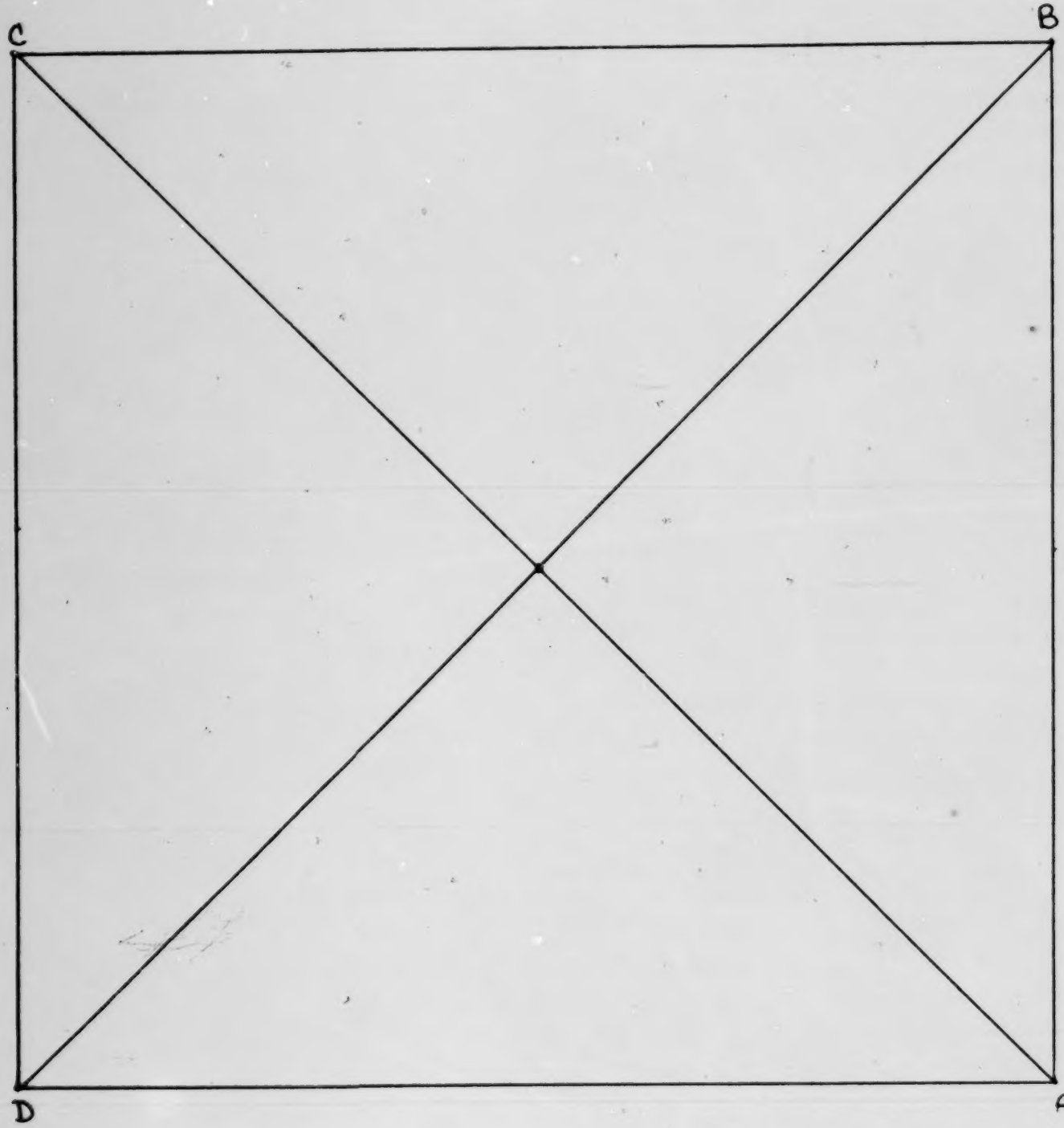
Materials needed: Pinwheel pattern for each child, straw and straight pin for each child, balloon full of air, paper dolls that will stand

Procedure:

Blow the paper dolls with the air from the balloon. Go into a discussion about things the wind does (moves grass, blows hair and people, moves windmills, etc.). "What is moving air?" Wind. "Let's see if we can make the wind do some work for us." Help them construct a pinwheel by inserting the straight pin through the dots (a, b, c, d and the center) of the pattern. Secure the end of the pin in a straw handle or the eraser of a pencil with enough pin on the pinwheel to allow it to turn.

Then let them improvize or find moving air to move their pinwheel (blowing air vent). Take the children on a parade and see how fast they must march to make their pinwheel turn.

PINWHEEL PATTERN



Energy Activity No. 4

Title: "Is the Sun a Thief?"

Concept: Alternative sources of energy such as solar, wind, fission, fusion, hydro, hydogen and geothermal which must be considered and developed.

Objective: Children will be aware of alternative sources of energy.

Subject Area: Science, Language Arts

Level: K-3

Time involved: 10-20 minutes

Materials needed: bottles, water, thermometer, grease pencil

Procedure:

1. Students can use a pan or bottle for this exercise. Each student group will need two identical containers and two thermometers. Since most of the students cannot read a thermometer, they can use a grease pencil, marking the initial and final readings. Interpretation can be based upon a change or use in the column.

2. Students will put one container in sunlight and another, filled with the same quantity of water, in the shade. Initial temperature readings should be taken. After one hour students should check their containers and make a final temperature reading.

3. Discuss with the students what has happened. Has there been a change in the water temperature? How can you tell? Has the temperature increased, decrease, or stayed the same?

4. Did the sunlight have any effect on the water temperature? Did the shade have any effect on the water temperature?

5. Option: Students can paint their containers with non-water soluble flat black paint and repeat the exercise. Did the black paint have any effect on the water temperature?

Energy Activity No. 5

Title: "The Generous Garbage Collector"

Concept: Limitations may be viewed as relative to changing energy demands.

Objective: Given the opportunity, the student will identify at least three things in his/her home that could be reused which are now wasted.

Subject Area: Science, Social Studies

Level: 1-2

Time Involved: 2 - 30 minute sessions

Materials needed: Labeled boxes for reusable materials, 9" x 12" drawing paper, Books: Dear Garbage Man, Eugene Zion, Scholastic Books, Just a Box, Goldie Taub Chernoff, Scholastic Books.

Procedure:

1. Read Dear Garbage Man, a book about a garbage man who goes on a saving spree. He gives things which people throw away to other people who might use them.

2. This book serves as a natural base for the discussion of reuse of materials.
   a. Discuss things that might be reused which are usually thrown away.
      - At home
      - At school
   b. Discuss how we can save energy by reusing paper and plastic.

3. Students will draw pictures of at least three things that they could reuse.

4. Students will be encouraged to bring items to school for reuse, such as; plastic bottles, magazines, margarine containers, old wrapping paper.

SUGGESTED CAREER AWARENESS ACTIVITY:

Invite a garbage collector to come to the class to be interviewed about his/her job.

Energy Activity No. 6

Title: "Grain for Grain"

Concept: Food energy comes from the sun.

Objective: The child will be able to trace food source (cereal) back to sun's energy.

Subject Area: Science

Level: K-3

Time involved: 30 minutes

Materials needed: Seed samples (wheat, oats, barley, rice, corn, millet), processed cereals (buckwheat, grapenuts, shredded wheat, puffed rice, cheerios, corn flakes, rolled oats)

Procedure:

Play game: Can you match the grain to the cereal?

If necessary group research will give more information about specific grains.

After the grains and cereals have been matched, have children point out how the grain had been changed (shape, size, color, texture, odor, etc.) when made into cereal.

By asking open-ended questions (i.e., What do the grains have in common?) lead the children to discover that seeds are actually stored energy from the sun.

Energy Activity No. 7

Title: "Save It!"

Concept: To conserve means to use wisely.

Objective: The child will be able to state some ways people can conserve different types of energy.

Subject Area:

Level: K-3

Time involved: 1 hour

Materials needed: Lollipops for whole class plus two for demonstration, conservation picture book.

Procedure:

The era of cheap energy ended forever with the '73 oil embargo. The new era would be known by the necessary conservation of fossil fuels, particularly oil and natural gas. Fossil fuels, unlike wind, water and the sun, can only be used once. This lesson is aimed at making children aware that adjusting their habits of energy consumption will conserve energy.

Two children may be chosen and each given a lollipop with instruction. Student A is to bite his lollipop and eat it up rapidly. Student B is to lick his lollipop so that it lasts longer.

The questions might be used during the demonstration. What is happening to Student A's lollipop? What is happening to Student B's? Whose lollipop will last longer?

Suppose I were a magician and changed these lollipops into something else. Something you would not want to eat but something you use all the time. Suppose I could turn this lollipop into a piece of coal (or oil or gas). How could I make sure I would have some left for tomorrow? (Use it more

Energy Activity No. 7
(continued)

slowly.) There is a word that means to make something last longer - can you think of it? Introduce the word "conserve." Write it on the chalkboard. Help the children use the word in sentences. Give each child a lollipop at end of discussion.

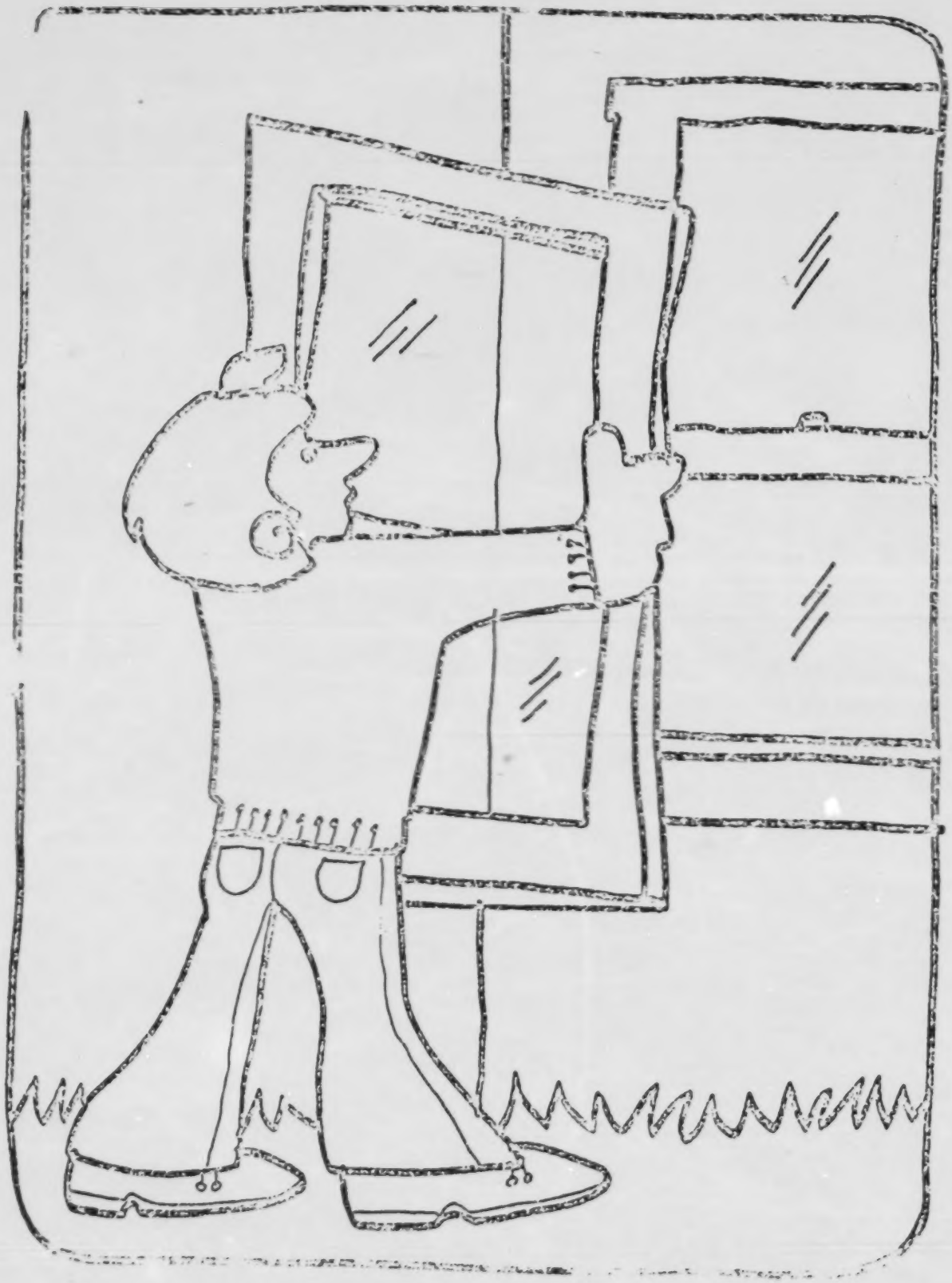
Introduce the Energy Conservation sheets that follow. The pictures may be used to lead into discussions on energy conservation. Let them try to guess how energy is being conserved in each one.

ENERGY

can be

CONSERVED

ON
OFF



Energy Activity No. 8

Title: "Food for Energy"

Concept: Food is an energy source.

Objective: Students will be able to recognize that when food is digested it becomes a source of energy.

Subject Area: Science

Level: K-3

Time involved: 30 minutes

Materials needed: Pencils, paper, crayons

Procedure:

Food energy is found in nutrients (proteins, carbohydrates, fats, etc.). Energy is released into the bloodstream during the process of digestion. Sugar is released faster than the other food elements but it is not the most nutritional. Food energy is measured in calories.

Introduce concept by asking: Do you eat cereal in the morning and follow up with questions to lead to discussion of process of digestion (teeth break up food and mixes with saliva and then to the stomach and intestines where it is changed to chemical and goes into the bloodstream to the cells).

Then lead the children through fast exercise or game that will make them tired. Lead them to discover that the food they had eaten provided the energy they used to do the activity. Ask "When you use up most of the food energy your body has stored, what happens?" (You get hungry!!!)

Make paper and crayons or pencil available for pictures of each child's favorite food and their favorite way of using the energy produced by that food. A sentance about their picture will make interpretation easier when displayed on bulletin board.

Energy Activity No. 9

Title: Energy Cube

Concept: Different kinds of energy

Objective: Children will be able to identify different sources of energy.

Subject Area: Art

Level: K-6

Time Involved: 30 minutes

Materials needed: large box, paint, glue, magazine, crayons, felt pins

Procedure:

1. Obtain a cardboard box from the grocery store.
2. Cover the entire box with colored paper or paint it.
3. Cover the box with interesting facts and pictures about energy. Use magazine pictures or have children draw their own illustrations.
4. Don't be wasteful, utilize your box for storage, puppet theater, quiet booth, etc.
5. A box for each different type of energy: gas, electricity, etc.

Energy Activity No. 10

Title: Drawing Energy Relay

Concept: Energy sources are all around the earth.

Objective: Students will become aware of energy sources around them.

Subject Area: Language Arts, Art

Level: K-3

Time involved: 5 - 20 minute sessions

Materials needed: Paper, drawing materials, list of energy sources

Procedure:

1. Arrange students in small groups (5).
2. Place paper and drawing materials beside each group.
3. Number the students in each group. Seat yourself away from the circles of students.
4. When the signal is given, the first student from each circle comes to you. He/she is to come without paper or pencil.
5. Tell each student the name of the first item on the list.
6. Each student returns to his respective group, takes the pencil and draws (without talking) the item until someone correctly identifies it using a soft voice.
7. The second person in the circle comes to you and tells you what the group has determined the drawing to be.

8. You then give that student a new object to draw.

9. Sample list of objects:

Sun	Wind
Steam	Factory Smoke
Wood	Trash collector
Apple	Dam
Plants	

10. Remind the students that if they yell out what is being drawn, others will hear.

11. The group to complete their drawings first is the winner.

SUGGESTED CAREER AWARENESS ACTIVITY:

Have the students draw a picture of a person working with one of the energy sources used in the activity.

Energy Activity No. 11

Title: Sun Mobiles

Concept: How the sun works for us.

Objective: Children will be able to relate to the work the sun does.

Subject Area: Language Art
Art

Level: K-3

Time involved: 30 minutes

Materials needed: Coat hanger, construction paper, crayons, string, stapler, picture of sun doing work: beach tanning, growing, food cooking, solar house, melting snow

Procedure:

1. Show class pictures of the work the sun does.
2. Let children brainstorm for more jobs the sun does.
3. Make a mobile illustrating sun jobs.

Energy Activity No. 12

Title: "Simon Says"

Concept: Energy is so basic that nothing moves or is accomplished without it.

Objective: Students will be able to realize that objects which move use energy.

Subject Area: Language Arts, Health

Level: K-3

Time Involved: 10-20 minutes

Materials needed: Powered toys, paper, magazine

Procedure:

1. Play "Simon Says" with the class doing simple motions. After a few minutes discuss what actions they just finished. Have them draw these actions using simple stick people. Tell the class that everytime they performed these actions they were using energy.

2. Using action toys in demonstration ask students what made these toys move. (Electricity, batteries, rubberband, muscle, etc.)

3. Students devise an inventory sheet to determine, "How do you use energy?" To do this students can make an energy picture composed of drawings, newspaper, magazine clippings or photographs showing the ways in which they individually use energy.

Energy Activity No. 13

Title: Energy Collage

Concept: Energy comes from many sources.

Objective: Students will become familiar with sources of energy by creating a collage.

Subject Area: Art, Science, Social Studies

Level: K-3

Time involved: 30 minutes

Materials needed: Magazines with many pictures of energy sources, scraps of energy related items (coal, material, wood), large piece of cardboard, scissors, glue

Procedure:

Have children look through magazines and cut out pictures about energy. Also have them look for words that "fit" with the energy theme.

Glue pictures in an overlapped pattern so that the cardboard is covered. Glue on words in appropriate places. Display collage in classroom.

Energy Activity No. 14

Title: "How Long Will It Last?"

Concept: All sources of energy are limited; most can be used only once.

Objective: Given the opportunity, the student will observe the depletion or limits of several common energy sources.

Subject Area: Science

Level: 1-2

Time involved: 7 - 30 minute sessions

Materials needed: Flashlight and batteries, candle, sugar cubes, raisins

Procedure:

1. Flashlight energy: Turn the flashlight on and leave it on until the energy is used up. Have the students estimate or predict how long they think the energy in the batteries will last. Relate this investigation to the idea that the electrical energy in the batteries will last only a certain amount of time. The energy is limited.

2. Candle energy: Using a small birthday candle have the students observe and estimate how long the candle will burn, giving off heat and light energy. Again, relate this investigation to the idea that energy stored in the candle will last only a certain amount of time. The energy is limited.

3. Food energy: Distribute sugar cubes to the class, one per student. Tell them to conserve it as much as possible and see if they can make it last for a couple of days as this is the only cube they will receive. At certain times during the day, have the students lick or nibble their cubes. Relate the activity to the fact the food energy the sugar has is limited. (It will last only so long until it is gone.)

a. Teacher should display a bowl of raisins in front of the room. Tell the students that they are going to experiment with raisins by eating them. Also, tell the students that they must see if they can make the raisins last for several days. Explain to the students that the supply is limited. When they are gone they will not be replaced. Instruct the students by telling them that at anytime they want a raisin to feel free in eating one. An honor system will determine how long they will last. Discuss with students the term limited and its implication to the earth's energy resources (i.e. resources are limited or finite).

4. As a summary, discuss with the students the meaning of "limited" using the experience the students have had with the activities. Relate this to limited energy resources such as coal, oil, natural gas and wood.

SUGGESTED CAREER AWARENESS ACTIVITY:

Invite the school cook to visit the class to talk about his/her job in relation to planning the use of food so that everyone gets their share of the limited amount of food that is cooked each day.

Energy Activity No. 15

Title: Biomass

Concept: Energy is so basic that nothing moves or is accomplished without it.

Objective: To show the role of solar energy in producing biomass.

Subject Area: Science	**Level:** 4-6	**Time Involved:** Several Weeks

Materials needed: Potting soil, flower pots, lima bean and pea seeds, analytic balance

Procedure:

1. Involve two or three children in a project to determine the gain in weight (mass) that occurs when a plant is grown from a seed.

2. Weigh carefully the amount of dry potting soil necessary to fill a flower pot. Moisten the soil and plant a small seed such as a lima bean or pea which has been weighed carefully on an analytic balance by a high school science student or teacher. Record the weight.

3. Place the flower pot on a window ledge in the classroom where it will receive available sunlight, water as needed, and permit to grow for several weeks.

4. Remove the plant and as many roots of the plant as possible from the soil being careful to save the soil since all soil used in the project should be dried and reweighed to ascertain the loss, if any, from the original starting material.

5. Dry the plant and roots thoroughly and weigh. How does the weight of the plant grown compare to the weight of the original seed? How does the weight of the plant compare with the change of weight in the soil? Where did the gain in weight come from?

6. How important was sunlight in this experiment? Could the dried plant be burned to produce energy? Where did that energy come from?

Energy Activity No. 16

Title: Energy Conversions

Concept: Energy is a fixed commodity being neither created nor destroyed but converted from one form to another. The means of conversion and the by-products of this conversion are important.

Objective: To understand how energy is converted from one form to another.

Subject Area: Science

Level: 4-6

Time involved: 1 hour

Materials needed:

Procedure:

During the consideration of how energy is converted from one form to another, arrange to take the class on a "field walk." Students, working together in groups of two or three, should be challenged to list all the energy conversions they can see or hear during a 15-20 minute walk. Ask each group to list their findings in a table such as the following:

Object Viewed or Heard	Energy Source	Conversion Product
Moving automobile	Gasoline	Motion
Moving cloud	Wind	Motion
Neon sign	Electricity	Light
Siren	Electricity	Sound

Ask each group to share its list with the class and develop on the chalkboard a master list of group findings. How many examples were reported by every group? What type of energy source predominates? What type of energy product is most common? Is electricity a "primary" or "secondary" energy source? What intermediate conversions might occur between an energy source such as gasoline in an automobile and the motion of the vehicle?

Energy Activity No. 17

Title: "Land of Energy-wise" Game

Concept: Energy, its production, use and conservation are essential in the maintenance of our society as we know it.

Objective: Students will become more aware of efficient energy-usage.

Subject Area: Social Studies, Math, Science

Level: Intermediate

Time involved: Variable

Materials needed: Energy cards, posterboard, bottle caps painted different colors to be used as place markers for the students

Procedure:

NOTE: This game is an enrichment activity. Concepts on the energy cards should be discussed and students should have an opportunity to implement ideas before game is played.

1. Make a game board for every 4 students.
2. Obtain dice and make place markers for each team.
3. Make positive and negative cards for energy-usage actions. Positive cards indicate efficient practices and negative cards indicate wasteful practices.
4. Roll the dice and go the number of spaces you roll. If a message is on the square, do what it indicates.
5. The winner is the person who gets to the Land of Energy-wise first.
6. After game, discuss how many people have different values and attitudes toward energy and the environment.

Energy Activity No. 17
(continued)

Energy Cards - Group A

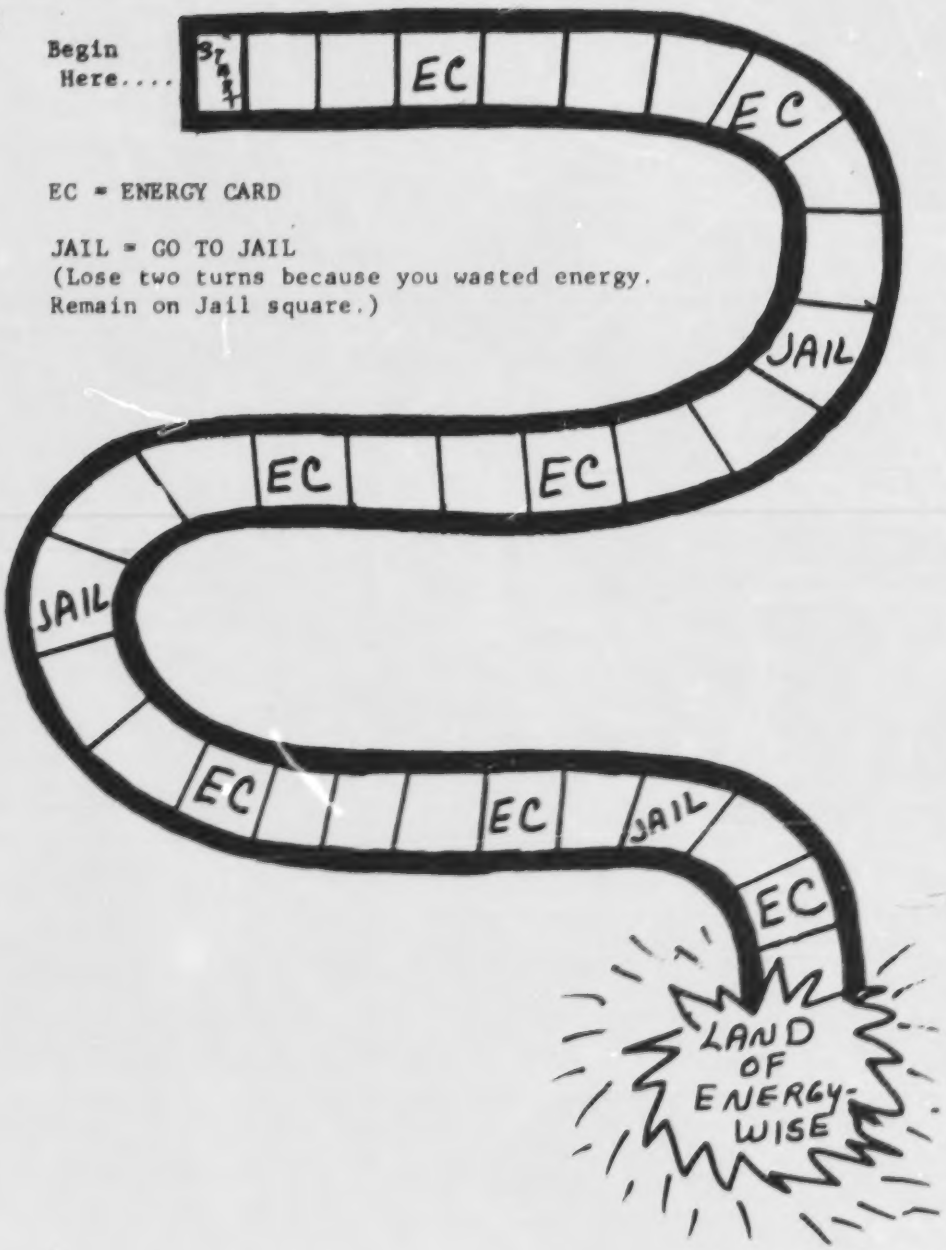
+2 if you turned off the light
+4 if you walk to school or rode your bike
+1 if you took a shower instead of a bath
+1 if you closed the refrigerator door
+3 if your family owns a 4 cylinder car
+2 if your thermostat is set at 68° or lower
+4 if your family has no air conditioning
+2 if you use fluorescent tubes instead of incandescent bulbs
+3 if your family has only black and white television
+1 if you turn off the radio when you leave the room

Energy Cards - Group B

-3 if you use an electric toothbrush
-2 if you use an electric blanket
-4 if your house has no storm windows or storm doors
-3 if you have a dripping hot water faucet at home
-4 if your family has a "luxury car"
-4 if your family has a color TV with instant-on
-2 if you have a self-cleaning oven
-1 if you have an electric knife in use
-1 if there's an outside light burning during the day at home
-4 if you leave the TV on when you leave the room

SAMPLE GAME BOARD:

Begin Here....



EC = ENERGY CARD

JAIL = GO TO JAIL
(Lose two turns because you wasted energy. Remain on Jail square.)

Energy Activity No. 18

Title: "Fuelish, the Energy User"

Concept: All industrial processes make use of several forms of energy.

Objective: Given the opportunity, the student will be able to recognize that we use many forms of energy daily in a great variety of ways.

Subject Area: Science, Reading

Level: 1-3.

Time involved: "free-time" activity

Materials needed: Fuelish and Energy User cards (see attached sheets.)

Procedure:

1. Directions to teacher: Make a single copy of the Fuelish card and 4 copies of each of the other energy user cards. These could be run on paper and mounted on cardboard or railroad board.

2. Game directions: To be played by 2-4 players in the same manner as Old Maid.
   a. Deal out all cards.
   b. The player to the left of the dealer draws one card from the player on his/her left. If the person playing can match a pair of cards, the pair is to be laid down.
   c. Then the person to his/her left draws in the same manner and play goes on until someone is out of cards.
   d. Scoring is as follows:
      +1 point for each card down when someone goes out.
      -1 point for each card still held.
      +3 points for going out first.
      -5 points if you hold Fuelish.

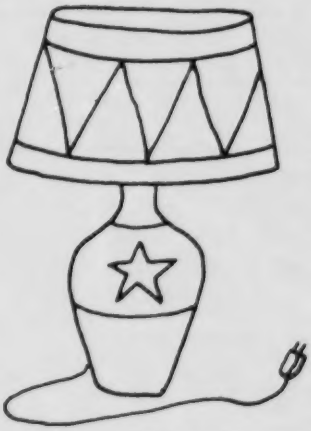
Energy Activity No. 18
(continued)

3. Older children playing this game could be required to hold all 4 cards of a kind before laying them down.

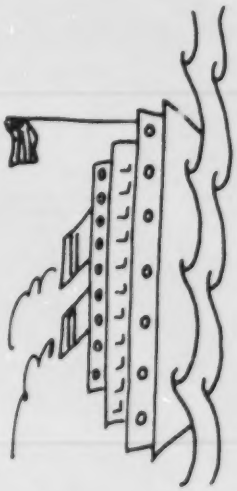
SUGGESTED CAREER AWARENESS ACTIVITY:

Additional cards depicting people who use the objects in their job could be made. The object and the person who uses it could be a match.

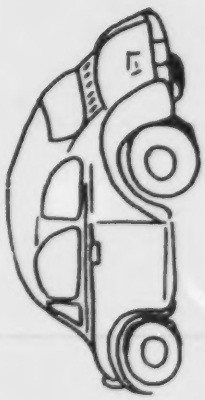
Energy User Cards



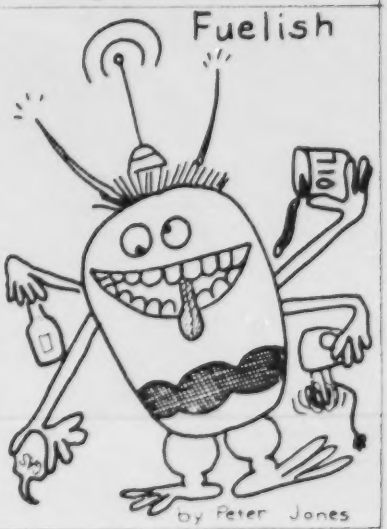
leaf



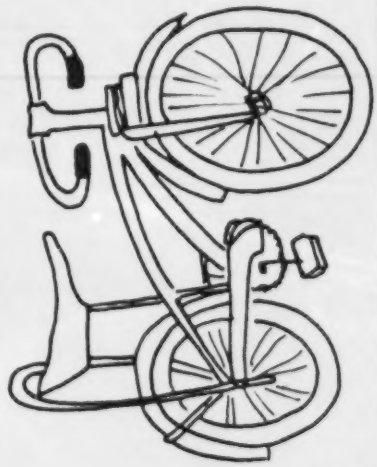
gas stove

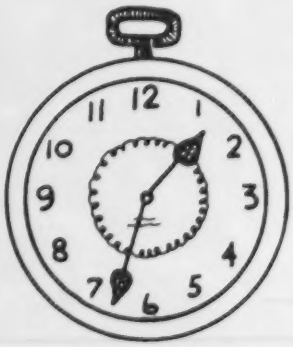


diesel bus



Energy User Cards





Energy Activity No. 19

Title: "Ways We Use and Save Energy"

Concept: Some human technologies and activities use more energy than others.

Objective: Given the opportunity, the students will understand that different amounts of energy are used in the production of everyday items in the environment.

Subject Area: Science

Level: 4-6

Time involved: Several sessions

Materials needed: Newspaper and magazines for clipping, colored construction paper for collage, film or filmstrip on production, pop bottle, paper for making a diary, paper for creating and illustrating a story or book, film on industrial production of some common item, such as the NBC "Hot Dog" series.

Procedure:

1. Display on chalkboard of chart headlines from newspapers or magazines relating to energy problems. Use these clippings as motivation for a discussion, starting with questions such as: "What is energy? Why do we need energy? What makes energy? What makes the lights get bright? What made your new shoes? etc." Let the classroom discuss. Then give statement: "Energy is the capacity for doing work." (Teacher information: Energy is measured in calories, kilowatt hours and other units.)

2. Write the following list of electric appliances on the chalkboard. Have students copy the words and write at least one advantage and one disadvantage for each:

toothbrush (electric)	air conditioning
toaster	radio
freezer	television
hot water heater	range
lights	dishwasher
heating system	

3. While the students are doing the preceding activity, copy the following list on another part of the board. Given in the table below are the relative amounts of energy used in operating various devices for one hour. The unit is the approximate amount of work a man could do in one hour (0.06 kilowatt hours). This list was taken from the Citizens' Workshops of the U. S. Atomic Energy Commission Handbook.

100 watt light bulb	2
Color TV	4
Manufacturing one pop bottle	10
Toaster	18
Air conditioner	50
Electric dryer	70
Oven - baking turkey	75
Small lawn mower	160
Gas log fireplace	300
Motor bike	500
Small car - 45 m.p.h.	1,000
Large car - 70 m.p.h.	4,500

4. Students share their list of advantages and disadvantages. Read together the list of energy used in operating devices. Listen for comments. With this additional knowledge have the students go back to their list of advantages and disadvantages. Some students may want to make some changes. The conclusion should result in such comments as: "Don't let hot water just run. Turn off lights and TV when not in use, etc."

5. As homework have the students write down each time they see a light on, a TV on, a radio on, etc. that no one is using. (This is best done over a weekend.)

6. Refer to homework assignment in activity 5. Have students share their homework.

7. So far the class has just talked about how much energy something uses. At this point discuss how much energy it takes to make a radio, a TV, a light bulb, etc.? Show a filmstrip or film of some type of production.

8. Display a pop bottle. Have students create and illustrate a story about "Polly the Pop Bottle." This story should tell the experiences the pop bottle may have from the time it is melted down glass until it is empty. Let the children imagine! (Fact: It would take ten men one hour, in energy form, to make the pop bottle.)

9. Refer to pop bottle stories. Have some students share their stories with class. The class may want to make individual books of their stories for others to read.

Energy Activity No. 19
(continued)

10. Discuss: Now the pop bottle is empty. Where does the bottle go? To the garbage? If it goes to the garbage or is broken what will have to happen to replace the bottle? What can be done with the bottle? (Example: Return to the store for deposit.) What can we do with ketchup bottles?

11. Plan a field trip to a recycling plant near your school. Students will observe glass being separated and broken to be melted and used again.

12. Students are to make a collage using magazines, newspapers, and art paper. The theme of the collage: "Let's Save Energy!"

13. Have students make a small diary recording events for the following month. Students are to record how they saved energy each morning as class begins. (Example: "I turned off lights, used little hot water, and turned off the radio when I wasn't listening.") Comments from the teacher regarding students' behavior will increase their awareness and reinforce their changes in behavior. (Good! Sally turned off the lights!")

SUGGESTED CAREER AWARENESS ACTIVITY:

Have students ask their parents how they use and save energy in their jobs.

Energy Activity No. 20

Title: "My Town's Energy Concerns"

Concept: Various energy sources have differing impacts on the environment.

Objective: The student will become aware of his community's energy concerns and how his community has been affected by its energy problems.

Subject Area: Social Studies, Language Arts

Level: 4-6

Time involved: Variable

Materials needed:

Procedure:

1. The teacher will ask the students questions such as:

   a. How is your home heated?
   b. Where does the electricity that services your house come from?
   c. How does that power plant generate electricity?
   d. What kind of fuel is necessary to heat the building where your mother, father, etc., works?

2. Students will search local newspapers for energy-related articles. (Small groups might be assigned a particular time for daily newspapers.) Students will examine articles looking for answers to questions such as:

   a. How did the newspaper handle energy-related problems?
   b. What sources of energy did the articles note?
   c. Where does our town get its fuel supply?
   d. How is our town's fuel transported to us?
   e. What kinds of energy-related problems has our town experienced?

f. How has our town handled these problems?

Optional Activity

Invite a representative of an environmental group, government agency, and/or local power company to speak about community energy problems. Thoughtful questions should be listed ahead of time.

3. Students will follow-up this activity by completing one of the following assignments:

   a. Write an essay or produce for the class an interview following a TV format on one of the suggested titles: "How the Energy Crisis Has Affected Our Town," "What are the Benefits as a Result of the Energy Crisis," "Our Town's Energy Problems," or choose a title of your own.
   b. List the new things he learned through these exercises.

Energy Activity No. 21

Title: "Thermostats Going Down"

Concept: Societal actions influence, extend or exhaust available energy resources.

Objective: The student will learn that by turning down the thermostat you can save energy and money.

Subject Area: Math

Level: 4-6

Time involved: 10 - 10 minute sessions

Materials needed: Thermometers, 2 charts

Procedure:

1. Make a classroom chart that will show the temperatures in your own classroom during the morning and the afternoon. Keep a record of the temperature for one week. What might be some reasons that the temperatures are different in the morning than they are in the afternoon?

2. Have the custodian lower the thermostat in your classroom by 1 or 2 degrees. Make another chart and keep a record of the temperature in your classroom for another week with the lowered thermostat. Compare the 2 charts. Do you notice any differences in the temperatures? During which week were the temperatures the lowest in your room?

   Now take a tour of your building and check the thermostats in the other rooms. Do you think they could be lowered a couple of degrees? How would this help your building save energy? Could you do this at home? How would this help your parents?

   - The students could make a chart and show the monthly cost of fuel for your school.

Energy Activity No. 21
(continued)

FOLLOW UP ACTIVITY:

Have someone from the electric company or gas company come to the classroom to present ways they conserve energy as a company; they can also pass on tips to students on what they can do to conserve energy at home.

Energy Activity No. 22

Title: Solar Energy

Concept: All forms of energy originated with the sun.

Objective: The student will know that the sun is the original source of energy.

Subject Area: Science

Level: 4-6

Time involved: 3 - 30 minute sessions

Materials needed: Photosynthesis chart, experiment for solar water heater

Procedure:

1. Have students list various energy sources and their relationship to the sun. Examples students might list:

Fossil fuels	Fossil fuels are formed from decayed plants and animals. Plants get their food through photosynthesis (see enclosed chart). In turn, animals eat plants or other animals. Both plants and animals need the warmth of the sun.
Geothermal	Geothermal energy is the earth's heat.
Water power	We need rain in order to have a water supply. Without the sun there would be no water cycle.
Nuclear	The cyclotron or "atomic gun" is used to speed up and release the nuclei of hydrogen atoms or the nuclei of helium atoms and split other atoms (fission). The cyclotron needs electrical charges in order to operate. This takes us back to the sun as the original source of energy.

2. Solar energy (the sun's heat and light energy) is being used to do work for us. Some examples are:

   a. Houses are being built to use solar heat.
   b. Solar cookers.
   c. Solar heaters (See the enclosed directions for an experiment demonstrating the basic principal of a solar heater.)

3. Have a guest speaker give a talk on solar energy.

4. Role-play being a solar engineer who has the job of inventing new things that use solar energy.

PLANS FOR EXPERIMENT ON SOLAR HEATER

Materials Needed:

1. Two picture frames approximately 8" x 10" or smaller, with the glass included.

2. Four pieces of black rubber tubing, each approximately 8" long and four pieces of light-colored rubber tubing. (Fingers from an old rubber glove could be used instead of tubing if tubing is not available.)

3. One piece black construction paper.

4. Lamp, such as a study lamp, which is flexible, so that it can shine directly down on the table. The lamp should have a 100 watt bulb.

5. A small water pitcher filled with water at about room temperature.

6. Thermometer

7. Scissors

Procedure:

1. Cut the black construction paper to fit the picture frame.

2. Insert the construction paper on top of the glass in the picture frame.

3. Remove the cardboard back, but not the glass, in the second picture frame, invert the frame, and place it over the first frame, which is lying on the table, in order to form an air chamber between the frames.

4. Tie knots in one end of each of the rubber tubes.

5. Fill the tubes about 3/4 of the way with water from the water pitcher and tie off the remaining ends so that the water is trapped inside.

6. Place a light- and a dark-colored, water-filled tube on the table next to the picture frame (solar heater).

7. Next, remove the top picture frame placing a light- and dark-colored, water-filled tube inside, on top of the construction paper, about 5" from the edge.

8. Then replace the top frame and place a light- and a dark-colored tube on top of the glass. (Place the tubes next to but do not cover the tubes under the glass.)

9. Finally, place a light and a dark water-filled tube a few feet away from the solar heater to serve as control specimens.

10. Place study lamp (sun) over the six specimens which are lying side by side, and direct the lamp so that all six specimens receive the maximum light intensity of about the same amount. The lamp should be about 10" above the specimens.

11. Allow approximately 45 minutes for the specimens to be exposed to the lamp or "sun."

12. While the specimens are heating up, the students may make the following chart:

Tubing	Control	Outside the heater	On heater	In heater
Light				
Dark				

After sufficient time, starting with the control specimen, cut the end of the tubing off, insert the thermometer, and record the temperature on the chart.

Next, repeat the procedure with the tubes outside heater, then the tubes on the heater, and finally, the tubes inside the heater.

If enough thermometers and space are available, eight groups of students may wish to participate in taking the readings.

Principle:

The sun's heat may be captured and used before it dissipates. Protected by sheets of glass, water is pumped over a black surface and/or through black pipes. The dark color absorbs much heat and transfers it to the water. The glass prevents the heat from radiating into the air. The heated water is pumped into tanks where the heat is exchanged into a heating system or hot water storage tanks.

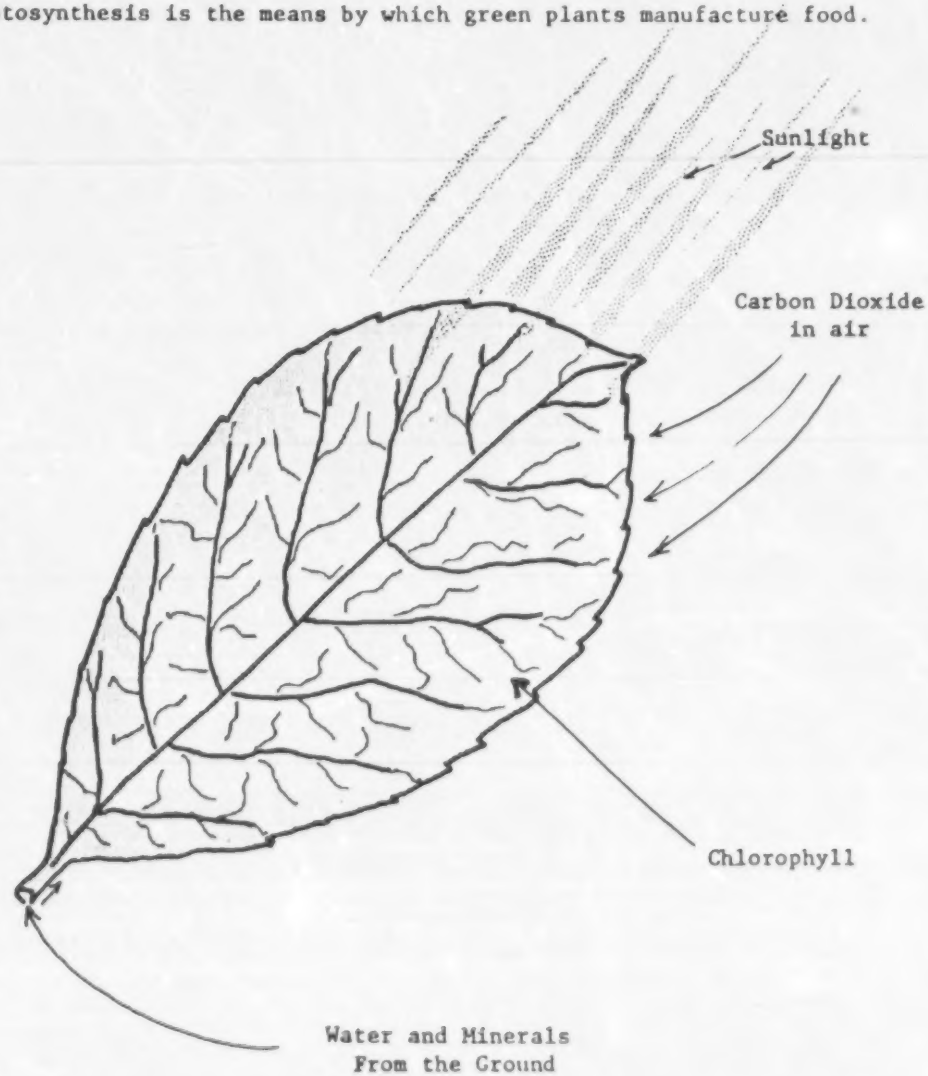
Energy Activity No. 22

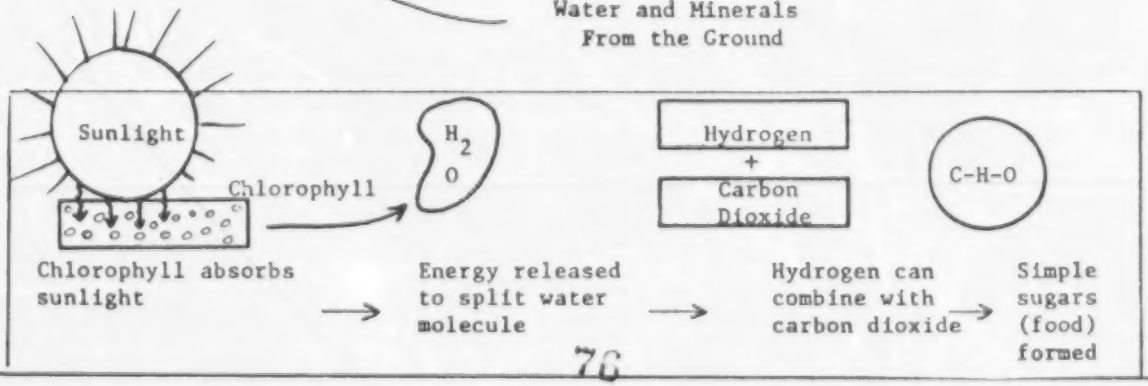
Sunlight - yellow
Chlorophyll - green
Leaf - green

Transparency

PHOTOSYNTHESIS

Photosynthesis is the means by which green plants manufacture food.





Energy Activity No. 23

Title: "Password"

Concept: Becoming aware of and using terms relating to energy and its sources aids in the understanding of energy.

Objective: The student will be able to identify and use vocabulary words related to the topic of energy conversion (electrical) in a game situation.

Subject Area: Language Art

Level: Intermediate

Time involved: 30 minutes

Materials needed: List of vocabulary words

Procedure:

1. Divide the class into two groups of approximately equal ability. Choose one student from each team to give clues and have them set at the front of the room. The game is played like the TV game "Password" except that each clue giver will be giving clues to his team rather than to one partner.

2. You may want to use the list of suggested words included, or add your own. (Students should be familiar with the words before the game is played.)

3. How the game is played.

   a. Each of the clue givers is shown the password.
   b. The clue givers then give one word clues alternately to their teams. You cannot use any form of the word in the clues.
   c. After giving a clue, the clue giver chooses someone on his team to guess what the password is. If that team member guesses the correct word, his team scores, and you begin a new round using a new password.

d. If the team member guesses incorrectly, the turn goes to the other clue giver, who gives a new clue and chooses someone from his team to guess.

e. After the word has been guessed correctly by one team or the other, the new word goes first to the clue giver who did not start the previous round.

f. Scoring: 10 points for the team guessing the word correctly on the first clue; 9 points if the correct word is guessed on the second clue; 8 points if the team guesses the password after hearing the third clue, etc.

g. New clues should be chosen from each team after every three or four rounds have been played.

Possible Words to be used in the Game "Password"

turbine	magnet	volt
steam	circuit	watt
battery	wind	kilowatt
generator	water	electron
generate	heat	neutron
electricity	light	charge
energy	quantity	positive
conversion	available	negative
convert	friction	produce
source	detect	reaction
power	detector	compass
current	insulated	appliances
static	instrument	conserve
experiment	coil	waste

Energy Activity No. 24

Title: Energy Puzzles

Concept: There are many different sources of energy.

Objective: The students will be able to learn energy facts and definitions by working puzzles.

Subject Area: Science, Social Studies, Language Arts

Level: Intermediate

Time involved: 20 minutes

Materials needed:

Procedure:

Unscramble letters to find the word that best answers each definition

a.	very small units of matter	mtoa (atom)
b.	a chemical source of electricity	lelc (cell)
c.	electrons move along paths called	icrsctui (circuits)
d.	materials which will carry an electrical current	ncduocrtso (conductors)
e.	materials that won't conduct an electric current	listrnuaos (insulators)
f.	a source of electricity from mechanical energy	erganrtoe (generator)
g.	the dense, central part of an atom	eluncus (nucleus)

Energy Activity No. 24
(continued)

h. the ability to work — yergne (energy)

i. atomic particles having negative charges — selencrto (electrons)

Unscramble these sources of energy:

a. rsloa (solar)

b. mpeerotul (petroleum)

c. ltaid (tidal)

d. loeeatghm (geothermal)

e. dniw (wind)

f. lnurata sga (natural gas)

g. olca (coal)

h. rwtae (water)

This could be used as supplementary to a lesson or activity on energy sources.

Energy Activity No. 25

Title: Collect Solar Heat With Metal

Concept: Light colors reflect the light and dark colors absorb light and heat.

Objective: The students will understand how different colors absorb or reflect heat.

Subject Area: Science

Level: 4-6

Time involved: 11 a.m. - 2 p.m.

Materials needed: Metal sheets, wood panels, red, yellow, blue, black, white, silver metallic paint

Procedure:

Teacher can either involve students in painting metal sheets or do it ahead of time. Paint these panels the colors listed above. A thermometer can be attached to each panel.

Have students set up the panels outside in the direct sunlight facing the sun. Possibly ask the students if they have any idea why they are doing this. Explain that you will be doing another activity and will be coming back to these panels in an hour or two. When you come back, ask each student which colored panel she/he thinks will be the warmest and the coolest. Then let each student feel all the panels.

Questions:

Which panel do you think will be the hottest? the coolest?

Do you see any relation to the seasonal colors we wear? What colors do you wear in the winter? in the summer?

Energy Activity No. 26

Title: "Collecting Heat With Colors"

Concept: Light colors reflect the light and dark colors absorb light and heat.

Objective: The students will understand how different colors absorb heat.

Subject Area: Science

Level: 4-6

Time involved: 2 - 15 minute sessions

Materials needed: Colored construction paper

Procedure:

In the winter when snow has fallen, bring out colored construction paper and lay it on top of the snow in the sun. Ask the students to predict which one will sink the most. Watch from the window or come back considerably later to find out the results.

Questions for discussion could include:

Which piece of paper was the hottest? coldest?

What colors do you wear in the winter? in the summer?

Do you understand why now?

Talk about what people wear in different regions such as the desert.

Energy Activity No. 27

Title: "Where Were You When the Lights Were Out?"

Concept: All resources are limited.

Objective: The student through role playing will realize how much the community is dependent upon electricity.

Subject Area: Science, Social Studies

Level: 4-6

Time involved: 2 class periods

Materials needed: Tape, tape recorder

Procedure:

First Day:

1. Assign students roles in a make believe community such as: mayor, police chief, fire chief, father, business man, etc.

2. Get together in small groups and let them discuss how energy affects the particular role they were assigned.

Second Day:

3. Diaster hits!! Black out!!! The lights are out and turn on tape recorder (explained later).

4. After first part of tape is over have them resume their community roles. In doing so they act out their community roles in regard to the black out. While doing so they try to decide what roles need more energy and what roles can get by with the least.

5. The teacher could add simulated problems that concern specific roles in the community. Example: A patient is on a kidney machine that requires electricity.

6. After discussion, play Part II of tape.

7. The teacher should brainstorm with the students and the should decide what community roles should be allowed to use the limited amount of energy. (The fewer roles they choose, the better.)

TAPE

First part:

Attention community members: We are now faced with an energy shortage. Due to an unusually high energy demand our electrical transformers are overloaded and we will be without electricity for an unknown period. Officials are working to relieve the situation. Please stay calm and function as normally as possible during the crisis.

Second part:

Citizens: We have a limited amount of energy available. Resume activities to a minimal basis.

Third part:

Students, the transformers have resumed full capacity. You may resume your usual routine. Thank you.

Energy Activity No. 28

Title: "Button Up Your Overcoat; Take Good Care of Yourself"

Concept: There are many ways of conserving energy.

Objective: Students will become aware that body heat can be conserved by insulating.

Subject Area: Science	**Level:** 4-6	**Time involved:**

Materials needed:

Procedure:

The day before ask each member of the class to bring in a pair of socks.

1. At the beginning of class have every one put socks on one foot only. Mention that at the close of the class period everyone will discover what this experiment is about.

2. Conduct your class activities as planned, or better yet go on a hike for at least 20 minutes. If not to the great outdoors, then around the building or to the football field.

3. Near the close of class, assemble students. Ask if their feet are warm, cold; wet from persperation, dry; blistered? Ask have you ever been cold outdoors, no matter how many sweaters or jackets you have worn? What is the limit for the layers of clothing to keep you comfortably warm?

NOTE: This activity would be more effective if you demonstrated with two students; each wearing 5 clothing items of their own choice.

Go outside for a specific task and upon their return ask them questions.

4. Relate to examples of insulation man has adapted from nature. Use these examples to start students thinking:

   a. Birds fluff their feathers to create air pockets to trap body heat.
   b. Hikers wear polarguard fiber-filled or down-filled garments.
   c. Discuss layers of fat as added insulation.
   d. Thickness of fur.

Energy Activity No. 29

Title: "Who Uses What?"

Concept: Each form of energy can be used in many ways.

Objective: The student will understand ways in which different energy sources may be used.

Subject Area: Math	**Level:** 4-6	**Time involved:** Homework

Materials needed:

Procedure:

1. Inventory your home block to determine the percentage of homes using the various types of energy - coal, oil, natural gas, electricity for water heating, space heating and cooking. Report your findings on a bar graph.

2. Look up the percentage of these sources as they are used nationally and compare it with your own. Compile your results with those of your classmates and draw a bar graph of the results. Compare this with the national percentages.

Energy Activity No. 30

Title: "Autosaur"

Concept: The shortage of some of our natural resources may be beneficial to earth's existence.

Objective: The students will be given the opportunity to realize that some day the automobile will be a thing of the past.

Subject Area: Language Arts

Level: 4-6

Time involved: 45 minutes

Materials needed:

Procedure:

Read to the class the following:

This is the year 3000. An Arizona newswriter has released a startling news story. He reports that during the 20th century earth was inhabited by huge metallic-looking beasts called "autosaurs." These monsters weighed between 1,000 and 4,000 pounds and could travel at terrific rates of speed. Although they could be ridden, they were never completely domesticated by the natives. Apparently thousands of natives lost their lives from them each year.

Around the last few decades of the century, he tells us the "autosaurs" mysteriously disappeared. Scientists believed they "starved" to death because of their depletion of food supply. A picture from a Los Angeles newspaper shows these creatures lined up before a feeding station. One of the natives is forced to feed the creatures by a means of a hose. This effort evidently was unsuccessful.

Energy Activity No. 30
(continued)

Conclusion: Although the extinction of any species is mourned, it does not appear that the ecological balance of that period was upset by the "autosaurs'" disappearance. There was proof that it even was improved.

Discussion:

1. Does the name "autosaur" relate to any type of invention we use today? Why/why not?

2. Do you think this could very well be possible in the future?

3. If the planet was improved by the disappearing of the "autosaur," how would you explain this advantage?

4. Make posters of different sizes of "autosaurs" that may have been found. Display around the room and have students explain how much "food supply" did it use and which do they think died out first. Why?

Energy Activity No. 31

Title: "What Was It Like Back Then?"

Concept: Every decision made involving energy affects standards of living.

Objective: The student will compare and contrast the life of an individual in the early 1900's to his/her own life today in either verbal or written manner.

Subject Area: Social Studies, Language Arts

Level: 4-6

Time involved: 2 - 30 minute sessions

Materials needed:

Procedure:

Each child will be assigned to interview a grandparent or someone who would know about "What was it like when you were my age?" "What different kinds of energy did you use?"

1. The teacher and class will discuss how life style in the U.S. has changed in the 20th century.
   a. Who do you know that may be able to tell you something about early 1900's?
   b. Perhaps the teacher will want to ask a resource person to come to the classroom (a practice interview).
2. The teacher will ask each student to interview an older person (at least 40 years old preferably in 60's) on "What was it like growing up?"
3. The teacher will send a letter home explaining the assignment.
4. The teacher could give each student a sheet of suggested questions.

5. The child will report to the teacher who he/she plans to interview.

6. During one week's time period, the student will interview (at home) and write a report on that interview. It would be desirable if each student could bring a picture of each person interviewed. The teacher and students will create a bulletin board of the different interviews. Students have a class discussion "What was the most interesting thing I learned about life and energy in the years past?"

   Students should write thank you's to the people they interviewed.

Energy Activity No. 32

Title: "Man on the Street" Interviews

Concept: Energy conservation is a community-wide project.

Objective: The student will develop first hand knowledge about what people in their community think about the energy shortage.

Subject Area: Social Studies, Language Arts

Level: 4-6

Time involved: Variable

Materials needed: Tape recorder

Procedure:

1. The teacher should discuss with students the need for community support to conserve energy. Stimulate the desire for the students to want to find out the views of the people in the community toward energy conservation.

2. Discuss the different roles of people in the community as related to energy conservation.

3. Students decide who they would like to interview in the community. Each should have a tape recorder to use during their interview. Each should include the following questions.

   a. Do you believe there is an energy crisis?
   b. Have you seen evidences that forms of energy are being used up?
   c. Has the energy shortage affected your job?
   d. In the year of 2000 which energy source do you think will be most used? Why?
   e. What are you doing personally to conserve energy? Can you do more?

4. Share and discuss the tape interviews with different points of views.

Energy Activity No. 33

Title: "Lighting: The Brightest"

Concept: There are many ways to conserve energy.

Objective: Students will compare the amount of heat and light given off by incandescent and florescent bulbs of the same wattage.

Subject Area: Science, Math

Level: 4-6

Time involved: 10-20 minutes

Materials needed: Incandescent bulb, florescent bulb, electrical socket, darkroom

Procedure:

In a darkroom have an incandescent light bulb and a florescent bulb ready to plug in. Ask students to look up the terms incandescent and florescent.

Bring them into the darkroom and ask questions such as: "Which bulb do you think will be brighter?" Plug in one at a time to see. Then ask questions such as: "Which bulb do you think will be warmer?" Plug in both bulbs and see if they can feel the difference. Which one uses the most energy? They both use the same amount of energy but the florescent bulb is a lot brighter, therefore, it would use less energy to light a room with florescent lighting because it would require less bulbs.

Energy Activity No. 34

Title: Electrical "Needs" vs. "Wants"

Concept: Energy, its production, use and conservation are essential in the maintenance of our society as we know it.

Objective: The students will determine necessary and luxury home electrical appliances.

Subject Area: Art, Social Studies, Science

Level: 4-6

Time involved: 1 hour

Materials needed: Magazines, paper, glue, catalogs, pictures of home and family

Procedure:

Have students bring to class pictures of their home and family, as well as catalogs and magazines. The students will go through the materials, cutting out pictures of things that need electricity and putting these pictures into 2 groups: those that their family needs and those "extras" that they want.

Discuss with the students the idea of necessities (needs) and luxuries (wants). After they have classified their pictures, have the students choose 10 electrical items that they feel are necessary to maintain their life style. (Those tney can't do without.) Have the students make a collage or module of the necessities.

Students can compare their answers and have a debate to support their point of view.

Create a one minute TV commercial to sell a luxury electrical item. A necessity.

Energy Activity No. 35

Title: "Energy from the Sun"

Concept: Energy from the sun has differing effects on the environment.

Objective: The student will learn that the sun is the original energy source and can demonstrate how different colors and textured materials either reflect or absorb solar radiation.

Subject Area: Science, Art

Level: 4-6

Time involved: 3 - 30 minute sessions

Materials needed: Boxes, thermometers, black paper and possible other colors, aluminum foil

Procedure:

1. The students are asked to line 2 boxes the same size and shape with different coverings. One box should be covered with black paper and the other box should be covered with aluminum foil. A thermometer with same reading is placed in each box and they are set in the sun for 10 minutes. A comparison is made of the different temperatures. How does color of roofing affect heating and cooling? How does the color of the clothes you wear in the summer and winter affect the heat retained and lost?

2. Students could line the box with black paper and cover with black paper. Line box with aluminum foil and cover with aluminum foil. Follow the same procedure above. Relate to types and colors of home coverings and insulations.

3. Have the students research how the sun affects the formation or availability of energy sources. Illustrate this information in a mural made by the class.

4. Show the film "Our Mr. Sun, Parts I & II." Discuss the importance of the sun and the fact that all life on earth depends upon the sun. It is our original source of heat and light energy.

Energy Activity No. 36

Title: "Preserve that Ice Cube!"

Concept: Heat energy and insulation.

Objective: The student will understand that insulating materials slow down heat transfer to help maintain cold or warm environments.

Subject Area: Science

Level: 4-6

Time involved: 1 hour

Materials needed: Ice cubes, plastic bags, insulating materials such as paper (various thicknesses), cardboard, styrofoam cups, aluminum foil, glass cups, metal cups, plastic containers, wax paper, newspaper, foam rubber, vermiculite, sand, small wooden containers, cotton balls, different cloth materials.

Procedure:

1. Organize teams of 2-3 students.
2. Tell students that you have collected some materials together for an interesting game. Each team will receive 1 ice cube. The goal of the game is to prevent the ice cube from melting for the longest time possible - they must keep it cool. Show the materials you can use to wrap the ice cube.
3. Give each group an ice cube in a plastic bag taped shut.
4. In order to keep track, place 1 ice cube in a plastic bag and suspend it by string. This ice cube will be used as a timer; when it is almost completely melted the game will end.
5. At conclusion, have students obtain the ice cube bags from their environments and compare the results.
6. Have the students identify the material which preserved the ice cube the longest. Did the thickness of the material make any difference? Ask them to think about the materials they would use if they played the game again.

Energy Activity No. 37

Title: Energy "Believe It or Nots"

Concept: New energy technology may be developed in the future.

Objective: The student will be able to research for interesting and unusual facts about energy.

Subject Area: Science, Art

Level: 4-6

Time involved: 1 hour

Materials needed: Art paper, crayons

Procedure:

1. Put the following on the board:

   a. A flea has the muscle energy to leap more than 100 times its body length.
   b. The roots of some trees have the power to split huge rocks.
   c. A cheetah can run at a speed of 65 miles per hour.

   These are just a few interesting and unusual facts about energy. See how many more you can find using encyclopedias, Guiness Book of World Records and other science materials.

2. Have the students make an Energy Believe It or Not booklet and share it with their classmates. Illustrate each energy fact for your booklet to make it fun to look at and interesting.

Energy Activity No. 38

Title: Showers vs. Bathtubs in Saving Energy

Concept: Presently most of our energy requirements are met through using fossil fuels. However, there are other alternative sources of energy such as solar, wind, fission, fusion, hydrogen, hydro, and geothermal which must be considered and developed.

Objective: To determine energy-saving bathing practices.

Subject Area: Science, Math	**Level:** 4-6	**Time involved:** 2 nights homework; 30 minute session

Materials needed: Bathtub, bathtub with shower

Procedure:

By now, students have heard energy-saving hints that ask the public to take showers and not baths. In this experiment, students can see for themselves that more energy is used in tub bathing than showering. Students can do this activity as a homework assignment and share the results in class.

1. Have students record data before they take a bath. Fill the bathtub as usual (preferred height and temperature). Before bathing, measure the depth of the water in centimeters. Record the temperature with a thermometer.

2. When it's time to bathe again, take a shower, close the bathtub drain so that your shower water will collect in the tub. Record data again. Compare this depth with your bath water depth. Compare temperature. Which used less hot water? By how much?

Energy Activity No. 39

Title: "Recycling, Stories and Activities"

Concept: Conflicts over ecologically sound practices and aesthetic judgments will involve trade-offs if they are to be resolved.

Objective: The student will be able to describe conflicts that can be resolved by technological recycling and/or reusing processes.

Subject Area:	**Level:**	**Time involved:**
All subject matter areas	K-6	Several sessions

Materials needed: Indicated on activity card

Procedure:

This learning activity package contains the following:

a. Teacher's Guide
b. A set of 40 activity cards
c. Three short story books on recycling/reusing

These activities are taken from: Energy and Man's Environment, Portland, Oregon. Our thanks is extended!!

TEACHER'S GUIDE

A Recycling Learning Package
for Elementary Students
by Dan Grimes

illustrated by Chloe Poole

NOTES TO THE TEACHER

TG-1

This learning package was developed for primary students, that they might learn about the concepts of recycling, conservation and problems with litter.

The content of the learning package includes:

1. Teacher's Guide - Ideas for use of material
2. Masters for "Poppy Pop Bottle" Story Book
3. Masters for "Mrs. Newspaper" Story Book
4. Masters for "Jan the Can" Story Book
5. A set of Recycling Activity Cards

Goal: The student will recognize that environmental management has effects on individuals and social institutions.

Objective: The student will describe three different types of recycling which reduces litter. These might include:

A. pop bottles
B. newspapers
C. cans

Activities: See activity cards to meet goal and objective:

A. basic introductory activities
B. extending the idea activities
C. culminating activities

Introducing the concept of LITTER
(consumer waste)

How To Get Started

In introducing the concept of litter and to set the stage for learning about recycling refer to Activity Card #1, #1a, & #1b. Through these activities the students will become personally involved with the problem of litter (waste products), have a better understanding of litter and will recognize a need for the concept of recycling.

Introducing the concept of RECYCLING

How To Get Started

To introduce the concept you can use the stories of "Poppy Pop Bottle", "Mrs. Newspaper" and "Jan the Can". These are simple stories telling about recycling.

After you have completed the activities related to one of the stories the students should have a good idea about recycling products. Continue with the other stories related to recycling and then begin working with the set of Activity Cards. Remember: the story books and activity cards are only suggestions to help the teacher in presenting recycling concepts in an innovative and creative way. Use your judgment on how to best use these materials.

Teacher Notes on "Poppy Pop Bottle"

The story illustrates the concept of recycling for primary students. The author has tried to show how a pop bottle is recycled many times. When you introduce the story discuss the word "recycling" with your students. Ask them what they know about a pop bottle being returned and reused again.

Read the story with your class and discuss the process involved in recycling pop bottles.

When the book is assembled and you've finished the story, ask your students if they can tell the story of recycling pop bottles.

Next ... do Recycling Activity Cards # 23 & 23a.

Teacher Notes on "Mrs. Newspaper" Story

The story illustrates the concept of recycling for primary students. The author has tried to show how a newspaper can be recycled, eventually to be used as newspaper again. Also the story illustrates that a newspaper can be reused in many other ways. If your community does not have a recycling center your students can learn about towns that do, as well as review recycling techniques they have available to them.

When you begin discuss the word "recycling". Ask the students what they know about reusing newspapers. Read the story and discuss the processes involved. Then see if they can retell this recycling story.

Next... do Recycling Activity Cards #24 & 24a.

Teacher Notes on "Jan the Can" Story

The story illustrates the concept of recycling for primary students. The author has tried to show how cans can be recycled.

When introducing the story ask your students how they might use a can. Ask them if they know what the word "recycling" means. Read the story and discuss the processes involved in recycling.

When finished with the story, ask your pupils if they can retell the story of "Jan the Can".

Next... refer to Recycling Activity Cards #25 & 25a.

Additional Resources for Further Study

Films:	Garbage Dumps	Ealing	1970	K-6
	Urban Ecology	Ealing	1970	K-6
	Litter Monster	Higgins	1970	K-6
	Garbage	King, S.P.	1969	K-6

Books: The Last Free Bird - Stone

Farewell to Shady Glade - Bill Peet

About the Activity Cards

The recycling activity cards were made to help facilitate the Recycling Learning Package by getting students actively involved in an awareness of the effects of litter, waste, conservation and recycling reuseable products.

The activities were designed to be easily integrated into Reading, Language Experience, Art, Science, Mathematics and Social Studies.

The cards fall into three groups:

A. basic introductory activity cards
B. extending the idea activity cards
C. culminating activity cards

The Story of Mrs. Newspaper

story by Dari Grimes pictures by Chloe Poole

Words to know:

newspaper	center
uses	factory
buy	mill
people	trash
recycled	reused
recycling	

Hi!

I am Mrs. Newspaper.
I have many uses.
I can be used over and over again.
Let me tell you about me.

People buy me
to read my news.

What will happen
to me when they
do not want me?

When people are done with me they take me to a recycling center.

Let me tell you about it.

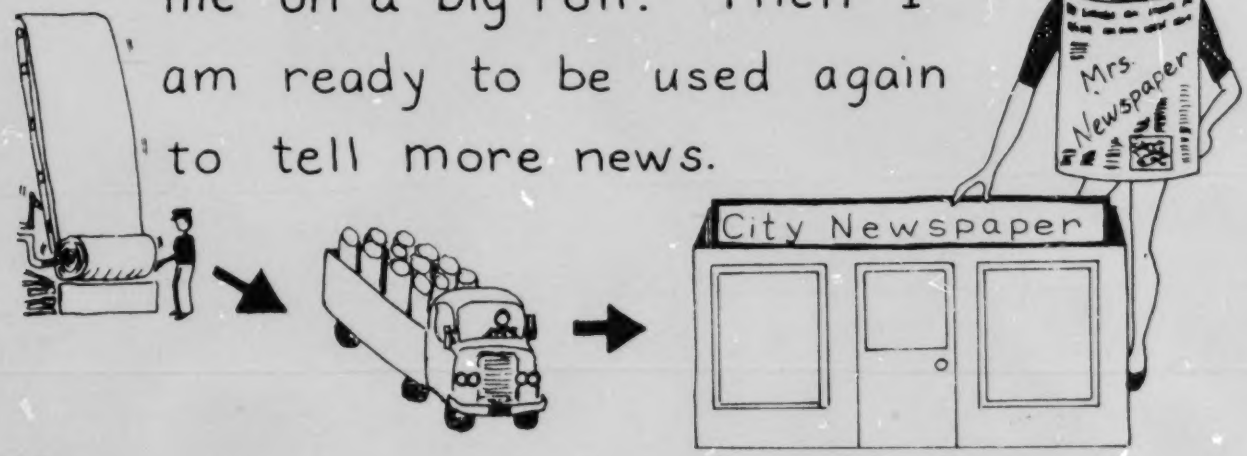
A recycling center is a place to take old newspapers.

Many cities have them.

Does your town have one ?

There, they put me on a truck. They take me back to the paper mill.

At the paper mill they wash me clean, press me flat, dry me out and put me on a big roll. Then I am ready to be used again to tell more news.

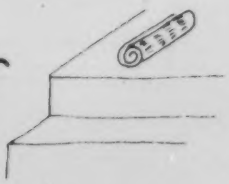


⑧

Wow!! I am ready to be sold again. People buy me again. They read my latest news.

or

or



or

⑨

I am happy. I am used over and over again.

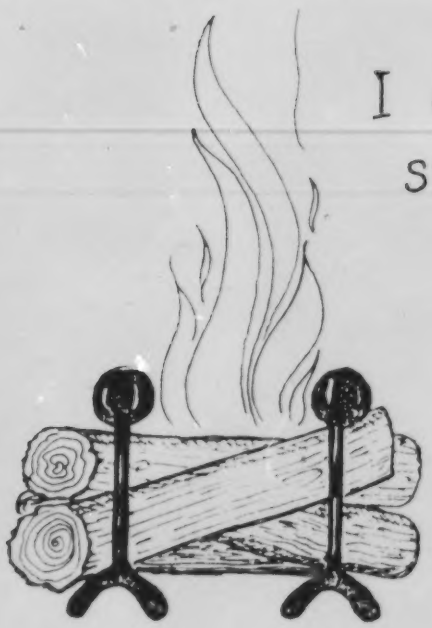
This is called recycling.

Let me tell you more ways I can be reused.

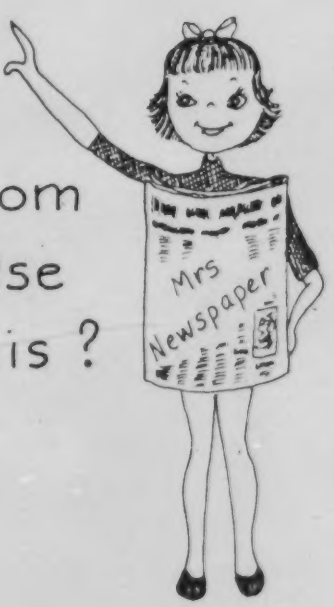
I can be used in trash cans.

I help keep
trash cans
clean.
Have you ever
used me
like this?

I can be used to
start a fire.



Do your mom
and dad use
me like this?

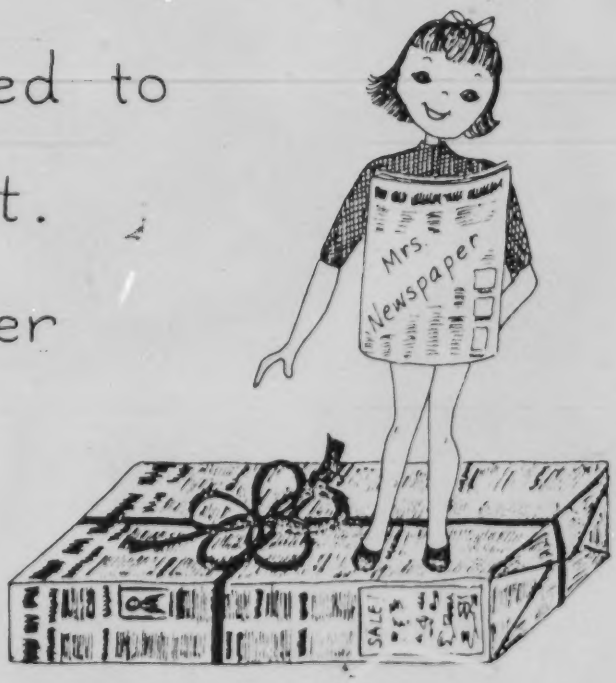


(12)

I can be used to
wrap things
that break.

(13)

I can be used to
wrap a gift.
Have you ever
used me
like this ?



(14)

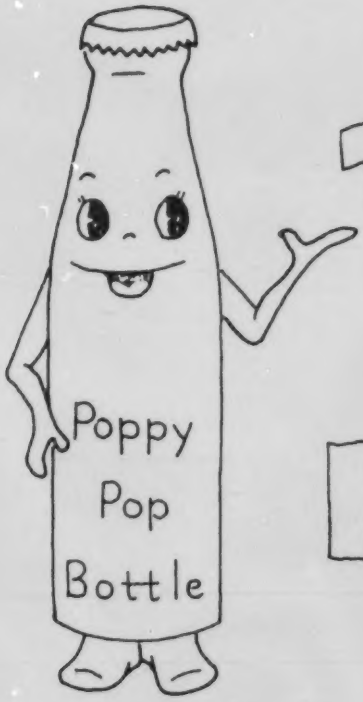
I am happy.
I am used
over and
over again.

Can you think of more things
I can do?

(15)

Can you tell the
story of recycling
newspapers now?

Tell your teacher.



THE STORY OF POPPY POP BOTTLE

Story by Dan Grimes
Pictures by Chloe Poole

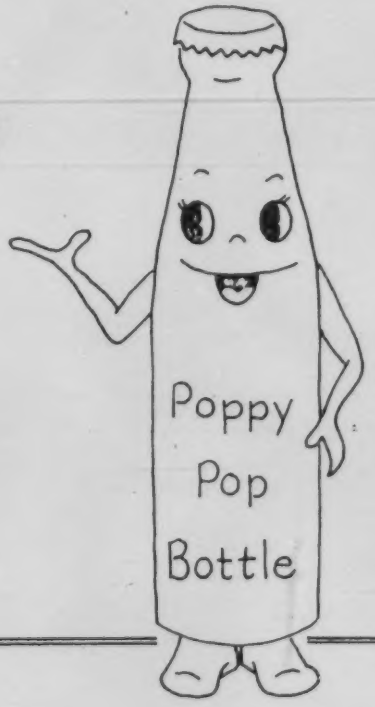
Words to know:

carton	money
factory	recycling
flavors	refund

grape ☐

lime ☐

orange ☐

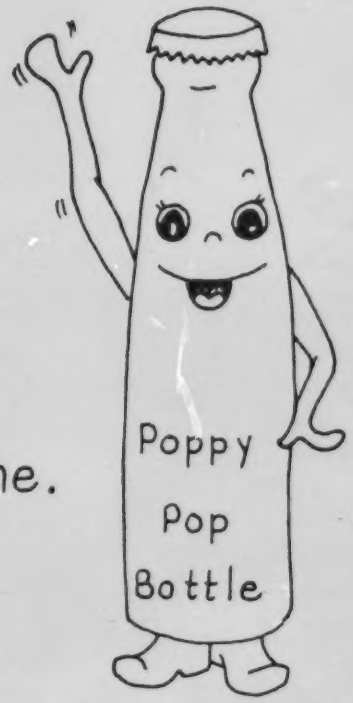


Can you color the blocks?

Hi! I am Poppy Pop Bottle.

I am happy.

Let us talk about me.



I am made of glass.

My pop is good to drink.

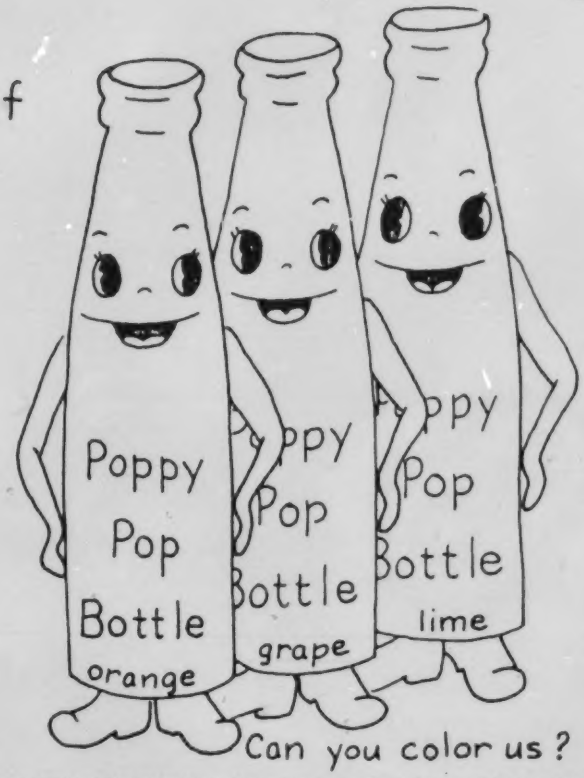
Yum! Yum!

I have a cap to keep
my pop fresh.

I come in all kinds of flavors, such as orange, grape and lime.

Boys and girls like my pop. They drink it fast.

I am used over and over again.

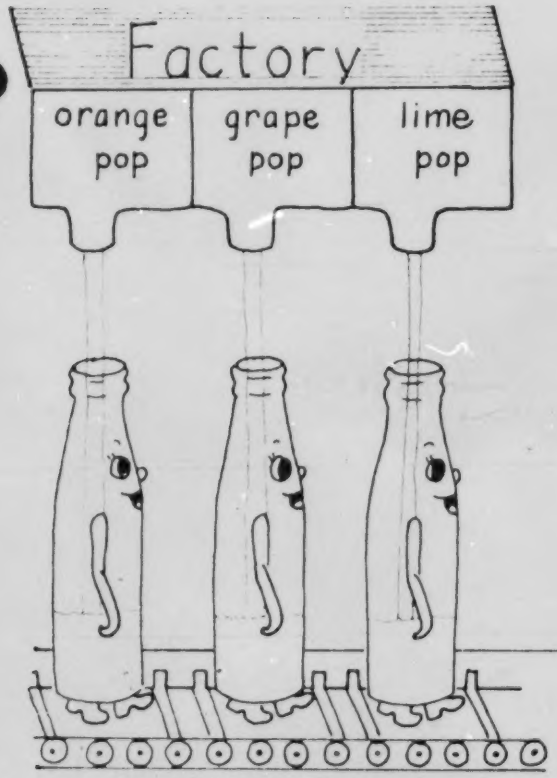


Can you color us?

Yes, I am happy.

I am used over, and over and over again. I can carry pop drink many, many times.

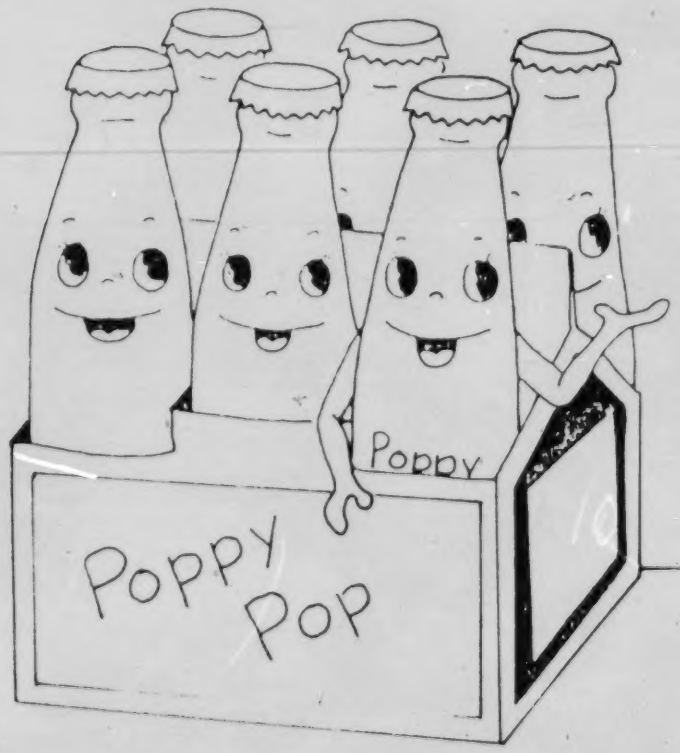
Let me tell you how I do this.



At the factory people make all flavors of pop. They put one flavor in me.

When I am full they put a cap on me.

← Can you color us ?



They put me in a carton so that I can be sent to the store.

They send me on a truck.

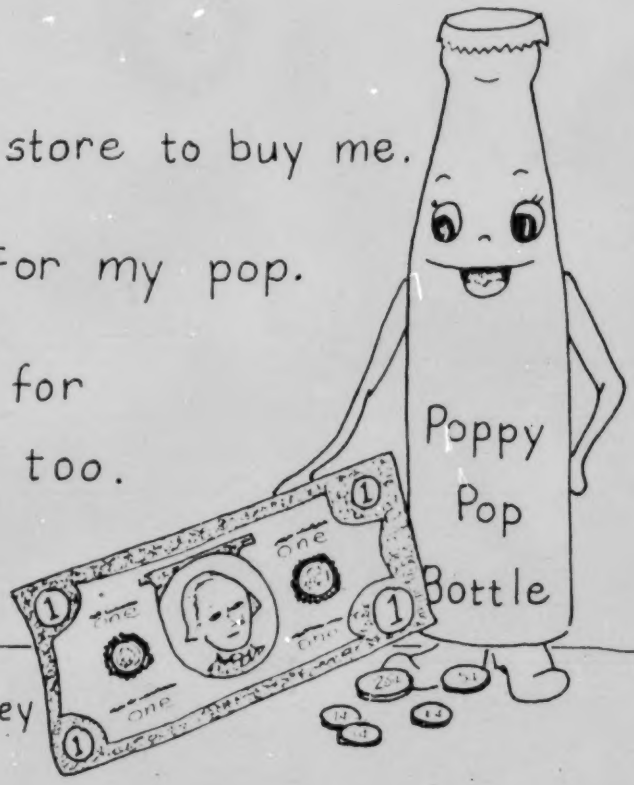
Can you color us ?

(9)

People come to the store to buy me.

They pay money for my pop.

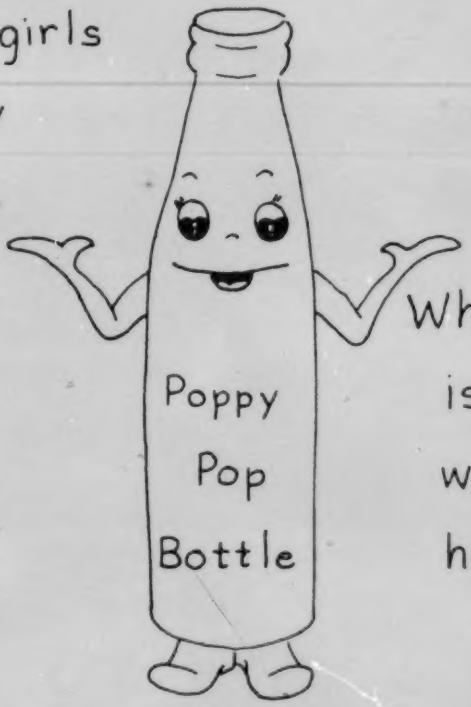
They pay money for
me, the bottle, too.



Can you color the money
and me too?

(10)

Boys and girls
drink my
pop fast.



When my pop
is all gone,
what will
happen to me?

All my pop is gone.

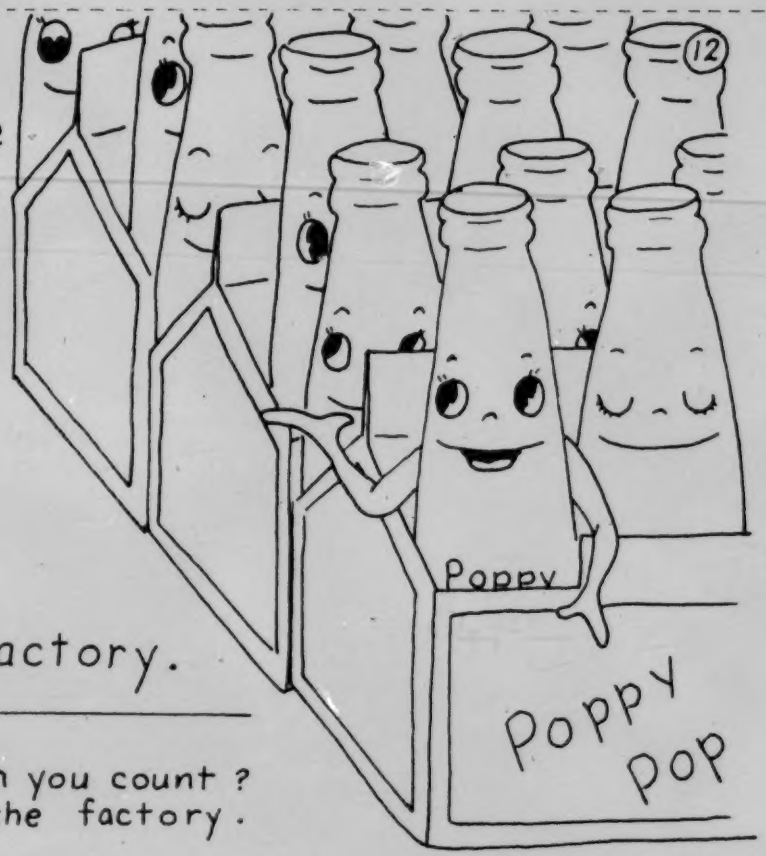
Boys and girls take
me back to the store.

They will get money
back for me.

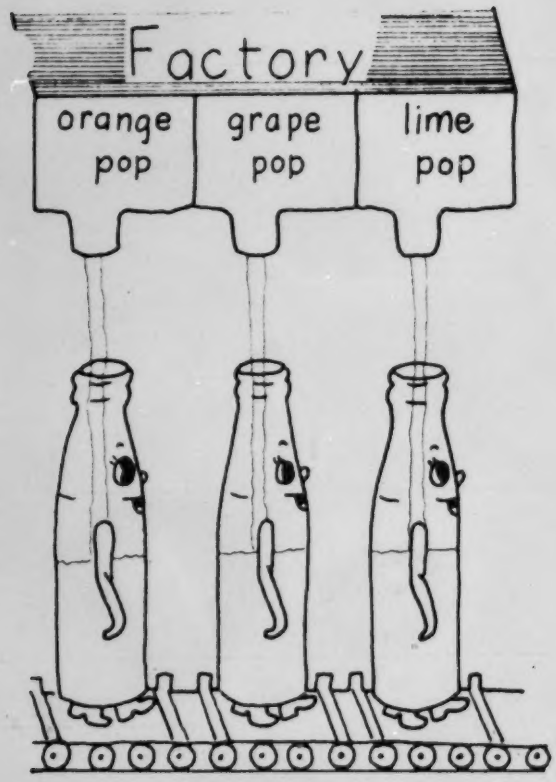
This is called a
pop bottle refund.

I am kept in the
store. A truck
will come to
pick me up.

I will go back
to the pop factory.



How many bottles can you count?
We will all go to the factory.



At the factory they will wash me.

They will put more pop in me.

Then I will go back to the store to be sold again.

Yes, I am happy because I am used over and over again.
I carry pop drink many times.
This is called **reusing**.
Can you tell my Story?

JAN THE CAN

A Recycling Story

by Dan Grimes

Pictures by Chloe Poole

Words to know:

factory
metal
shape
recycle
recycling

Hi! boys and girls.

I am Jan.

Let me tell a story.

I am a can.

I carry many things. Can you name some ?

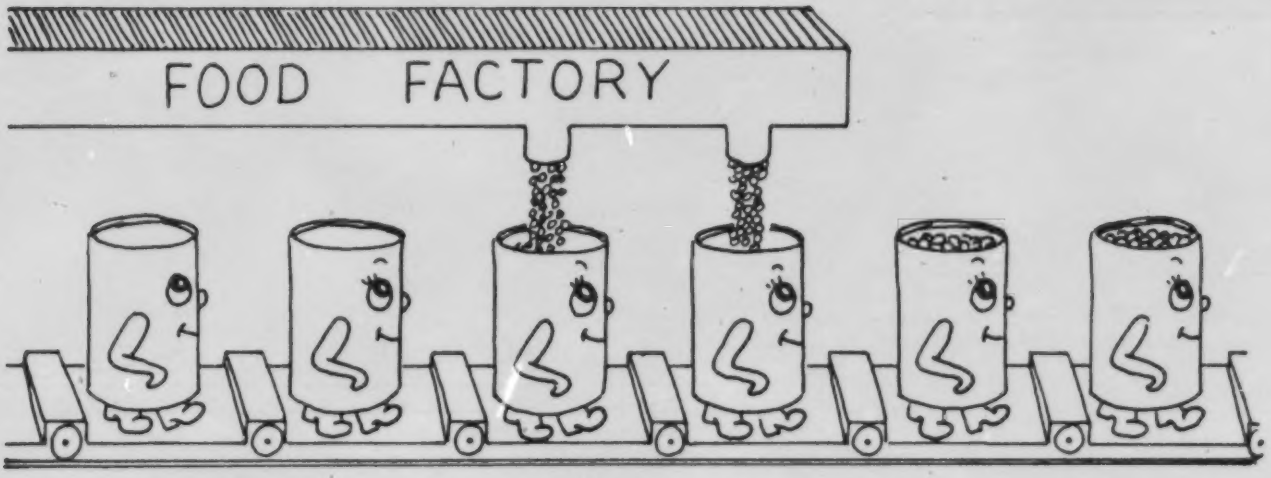
I am made
in a factory.

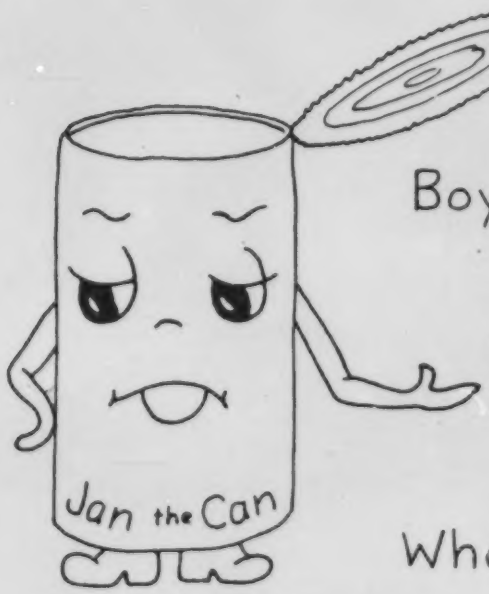
I am made
of metal.

I am made
in many shapes.

Sometimes food is put inside me.

Boys and girls eat my food.





Boys and girls like my food.

My food is all gone.

What will happen to me?

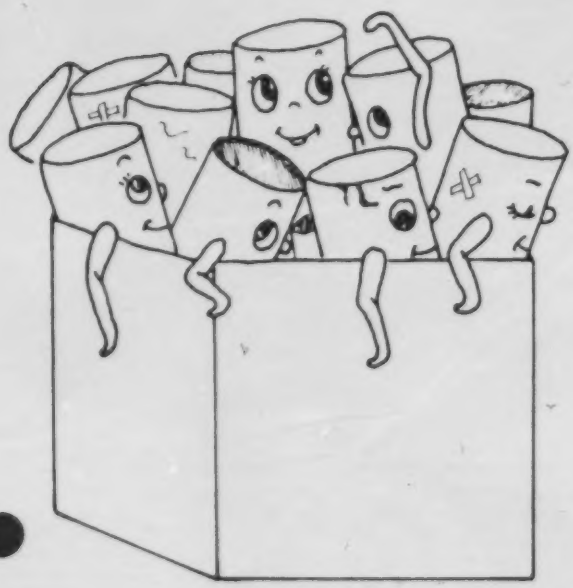
Wow! I can be used over and over again!

Let me show you.

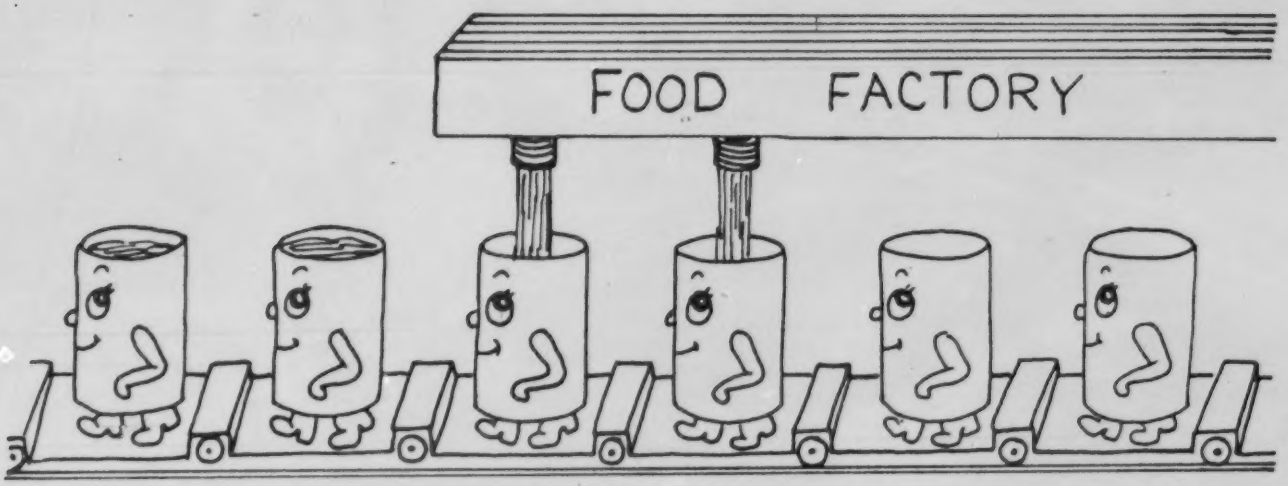
I can go back to the factory.

They would melt me.

They could make me new again.



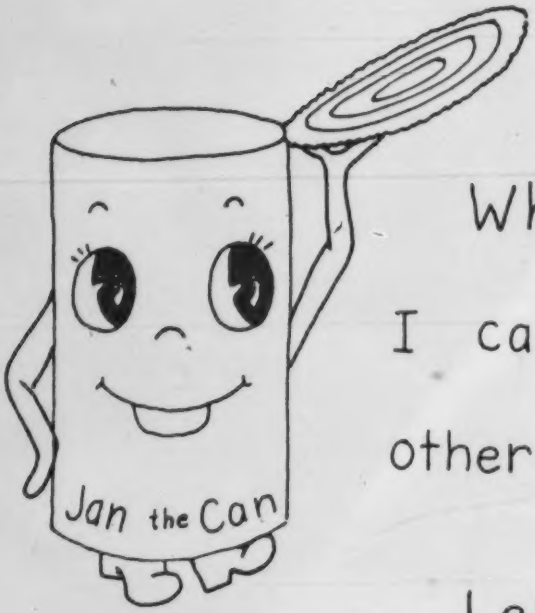
I am happy. They will use me again. They put food in me again. Boys and girls will eat my food.



I am happy when I am used over and over again.

This is called

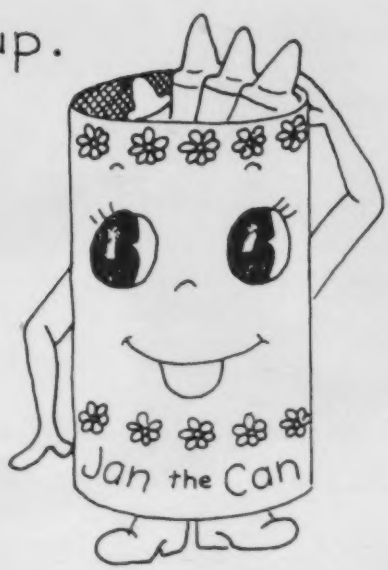
reusing

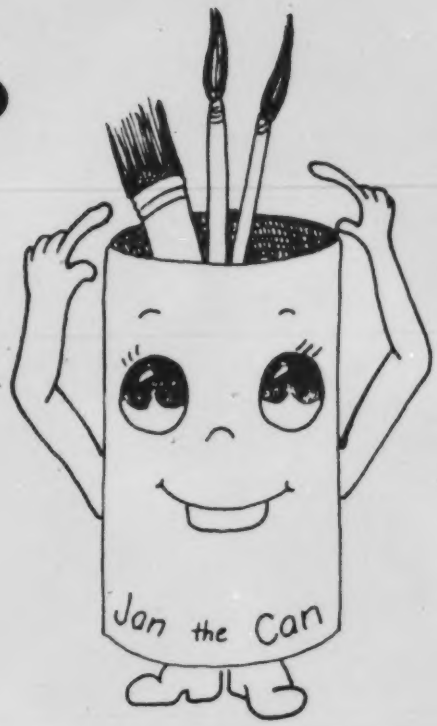


When my food is gone
I can be used to do
other things too.

Let me show you.

You can dress me up.
I will hold your
crayons. Keep me
in a desk.
I am happy.



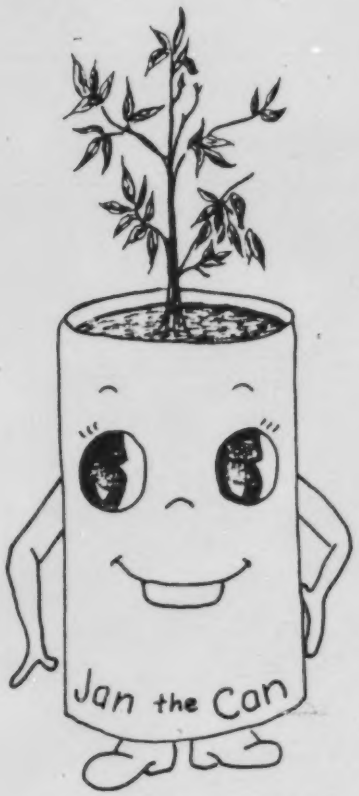


I can hold a brush.

I am happy with a brush.

I can hold a tree.

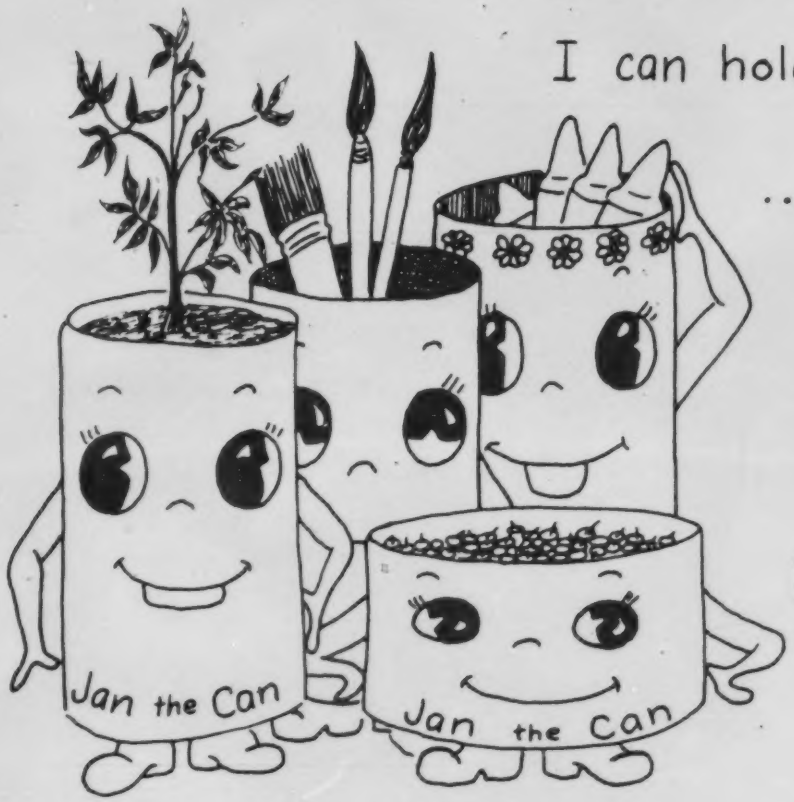
I am happy with a tree.



I can hold a tack.

I
am
happy
with
a
tack.

I can hold lots of things.



... a tree
... a brush
... a tack
... a crayon

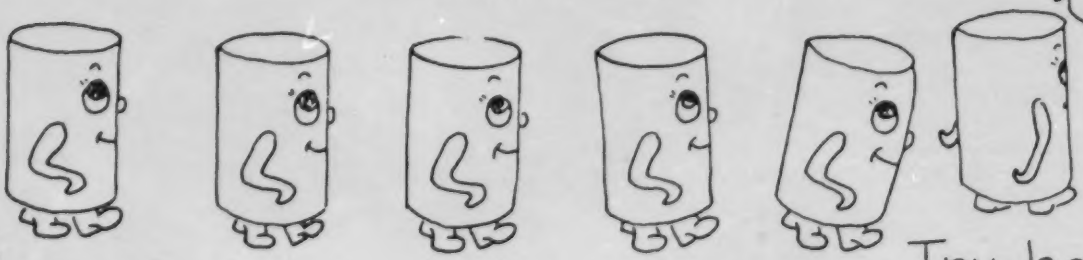
I am happy!

I am happy when I hold things.

Now... can you make me happy?

Think of something I can hold for you.

I have many uses. I can be used over and over again. This is called reusing. Can you reuse me?



Try hard !!!

Recycling Activity Cards

Basic 1

Objective: Student will be able to say orally or write a meaning of the word litter and give an example.

Activity: Sprinkle garbage in the hall of the school (waste paper, books, cartons, containers, clothes, old shoes, etc.). Teacher observes and lists who notices or picks up litter. Eventually discuss the problem of the litter in the hall and ask questions like these:

A. How does the litter in the hall make you feel?
B. What would it be like if no one cleaned it up and more was added each day?
C. What rules would you make to keep the area clean?
D. How is our problem of litter like the problem in communities?
E. What rules would you make to keep the community clean?
F. What do you think the word litter means?
G. Let's make a list of kinds of litter we have in our community.

Extending 1a

Subject Content Areas: Science (classification of objects) observing, Decision making, Language Arts, Language experience charts (teacher writes what students say), Creative drama, Art.

Activity: Take your students on a short walk around the school yard and surrounding area near roads. Make a collection of different kinds of litter they see. Bring to classroom and make a display and then decide what to do with your collection. Explore alternatives and select best one by vote.

Stress the idea that recycling waste helps to reduce litter. Also that some people and factories reuse such things as newspapers, bottles, and cans to help reduce litter and waste. Point out that it takes a lot of hard work to carry out a litter and recycling campaign!!!

Extending 1b

Objective: Creative drama

Activity: Have students act out the part of a piece of litter.

Suggestions: Dress up like litter. Have litter coming out of actors' pockets, shoes, dress, shirt, hands, hair, etc.

Presentations can be in the form of pantomime or charades.

If dialog is desired have students make up a script or do impromptu: "If litter could talk, what would it say?".

Extending 1c

Objective: Creative art

Activity: Have students draw and color pictures. Subject areas could be:

a. your litter walk
b. your litter display
c. litter classifications
d. litter seen in the community
e. litter seen on vacations

Activity: On one half of the paper have students draw and color a picture of a landscape that is polluted with litter. On the other half, have them draw and color a picture of a litter-free landscape. Have a discussion about both pictures. Which is better? Why?

Extending 2

Objective: The student will be able to describe what role retail grocery stores play in recycling bottles and be able to list three jobs at the store.

Activity: Take the students to your local supermarket or grocery. Have the store manager give you a tour of the area where returned bottles are stored. Ask the manager to explain the deposit - refund process. Ask him to explain the storage - pickup - delivery system. If possible, try to schedule your visit on the day the bottles are picked up by the distributor.

Discuss what recycling means.

Culminating 2a

Objective: Creative art - Language experience - Career awareness

Activity: Have your students draw and color a picture of your trip to the grocery store. Show the workers you saw, the bottles being returned and stored, and/or the truck that picks up the bottles. Have the students share the pictures with the class.

You can also use the student drawings for Reading. Have the children tell a cooperative group story about a picture. As they tell you what to write put the story on the board for them to read.

Basic 3

Objective: The student will make a poster, collage or mobile using litter as the working material.

Activity: Have the students go on a litter drive around the school and/or community. With this litter have them make posters, collages or mobiles that depict the types of litter exist, as well as showing how litter hurts the scenery.

Make up slogans to put on the art work.

Display the work around the room, school and community.

Stress the aesthetic value of the environment and how litter destroys its beauty.

Extending 4.

Objective: The student will be able to list ways a milk jug may be recycled or reused.

Activity: Bring to class a glass milk jug. Discuss with your students how the jug is or might be reused. Stress the idea that many people who buy milk prefer to use glass jugs because they are reused by the dairy. Tell the students that if we buy milk in returnable containers, there will be fewer milk cartons to throw away and therefore, less waste and litter.

Discuss with class what recycling means.

Extending 4a

Subject Content Areas: Career Awareness, Art, Reading, Language, Creative Drama.

Activity: Have your students draw and color pictures of the milk jug being used for different things or how it might be used again as a milk container.

Use their pictures for a language experience. Have the student dictate a story to you. Attach it to his/her picture for him/her to see and read.

Have students act out the uses of a milk jug. They could do this in pantomime or with puppets.

Basic 5

Objective: When given a variety of materials the student will decorate used bottles and list several ways they can be reused at home or at school.

Activity: Have the students bring used bottles to school. Using decorating material such as paint, yarn, art paper, contact paper, stick-ons of all kinds, cloth, etc., decorate the bottles. Have the students make a list of all the ways they will use the bottles at school or at home. Discuss the idea that you are recycling the bottles by using them over again.

Suggestions: You can make flower vases, planters, puppets, storage containers, etc.

Extending 5a

Subject Content Areas: Art , Language Arts

Activity: Have the students draw and color a picture story of where and how they intend to use their decorated bottles.

Using the picture stories the teacher can write student-dictated sentences for reading.

Students may get oral language experience by telling the story they have illustrated.

Basic 6

Objective: The student will be able to describe how a beverage manufacturing plant recycles their own bottles for reuse and will be able to list at least three jobs involved.

Activity: Take your students to a local beverage plant for a field trip. (This could include plants that bottle catsup or other cooking items.) Have students observe a recycling process. Also observe the various jobs found in the plant.

When you get back to the classroom, discuss and/or draw pictures of your trip. Discuss what recycling means. Discuss the careers you observed.

Extending 6a

Objective: The students will demonstrate an understanding of factory work and workers.

Activity: Have your students simulate a pop bottle factory with assembly line work. Student stations could be (a) unloading empty bottles; (b) washing the bottles in a small dish pan; (c) drying the bottles; (d) filling the bottles with colored water; (e) putting a plastic cap on the bottles; (f) packing them in paper cartons; (g) stacking them in the "warehouse" part of the room; (h) delivery to the classroom store"; and finally sales to the consumer. Then the second phase begins with (A) the buyer; (B) the user; (C) return to store for refund; (D) store sorts and stores; (E) return bottles to factory area to begin cycle again.

.....see card 6b

Extending 6b

Subject Content Areas: Career Awareness; Creative Dramatics; Social Studies; Art.

Activity (cont.) Divide the class into small groups. Each group has one of the special jobs mentioned. (Division of Labor) Start at the factory and keep going until all bottles have made the complete cycle at least once (or more).

Materials suggested: Four six packs of empty bottles or more. Paper cartons for bottles. Corks or plastic caps for bottles. Water and food coloring. Soap, dish pans, towels. Play money.

Signs for your stations will help. Students could make these.

Extending 6c

Subject Content Areas: Art , Language Experience

Activity: Have students draw and color picture stories of the factory building, how bottles are filled, and people at work. Be creative. OR... Have them draw themselves at work in your simulation experience.

Have the students tell the story of the pictures. Write the story or tape it for all to see, hear and/or read.

Have them tell: how it felt to work as a team to complete the full cycle; how it felt to do the same job over and over; were they able to do it better or faster with experience?; etc.

Basic 7

Objective: The student will be able to describe what role a newspaper recycling center plays in recycling paper. He/She should be able to tell about one job at the center.

Activity: Take your students to a local newspaper drop. Arrange for the manager to describe the process of recycling the papers. Have him/her explain:

a. who brings the papers to the drop?
b. who bundles and sorts the papers?
c. where and how the papers are shipped?
d. how the papers are reused?

On return, discuss what you saw and heard. Discuss what recycling means and why it is important. Draw pictures of your trip.

Basic 8

Objective: The student will be able to tell ways an egg carton can be reused.

Activity: Bring an egg carton to class. Discuss with your students how that egg carton could be reused rather than thrown away. Make a list on the blackboard. Discuss the word recycling.

Have the students reuse egg carton in a class project for something that can be used at school or at home.

Egg cartons can be decorated as storage boxes, made into egg cup puppets, soaked down to make eggcarton papier maché, used as base for the Math game "KAHLAH", etc. Be creative!

Basic 9

Objective: The student will make up environmental management rules for the classroom.

Activity: Discuss with the class the rules people should follow concerning litter. Why are these rules important? Make up rules the class will follow about classroom litter and recycling that litter. Try to state the rules in positive terms rather than negative. Decide what the consequences will be if the rules are not followed. Point out individual responsibility and team effort. Elect a class enforcement officer. Court cases may arise. Have a court session if necessary. Invite a policeman to come to class. Ask about litter and recycling laws. What is the importance of these laws? How are they enforced? What do people need to know about them? How can the class help?

Extending 9a

Subject Content Areas: Language Arts, Social Studies, Art, Career Awareness

Activity: Have a Poster Campaign to stamp out litter in your school or community.

Develop a spelling-vocabulary list of words to use. Work together to develop some short, simple, slogans. Discuss some impact, attention getting, posters for ideas.

Contact local business people for permission to display your posters. Study the school for the best and most visible places for display there.

Make simple posters concerning litter elimination.

Culminating 10

Objective: The student becomes aware of how people reuse and recycle products.

Activity: After your students understand the concepts of litter and recycling, discuss with them the idea of interviewing adults in the school and community about the ways they recycle or reuse waste products at home or on their jobs. Have students share with the class the information they collect. Keep a wall chart. List each new idea as well as data on the most common practices.

Discuss the outcome of your survey. Are most of the people interviewed really practicing recycling? Did you get many new ideas? What else did you learn?

Culminating 11

Objective: The students will become actively involved in the recycling process.

Activity: Make a plan with your students for a paper drive. Check with your County Extension Agency for information. Check with places that accept paper collections. At times you can make money for each ton of papers. Arrange with your school custodian for suitable, temporary storage.

Have your students collect newspapers in the community and bring them to school. When your stock is large enough, arrange for pickup by the recycling center or firm buying your paper.

Many math activities can be based on this project.

Culminating 12

Objective: The students will become actively involved in the recycling process.

Activity: Take your students on a returnable bottle hunt. Bring the bottles back to school. Have the students figure how much the bottles are worth. Take the bottles to your local store for the refund. Make a class decision on how the money will be spent.

Observe the areas of the community on the hunt. Are some places more prone to collect litter than others? Why? Make some comparisons. Record your data.

Culminating 13

Objective: The students will become involved in recycling at home.

Activity: Have the students discuss with parents the idea of recycling newspapers, bottles and cans. Encourage them to try to set up a program at home for recycling. Have students report their progress. Keep a wall chart or other record system for a period of time. Continue positive reinforcement of the concepts. Encourage participation in the project until new habits are formed.

Note: It might be a good idea if the teacher sends a note home explaining to parents that the child is involved in recycling activities at school.

Culminating 14

Objective: The student will observe that newspapers, if prepared properly, can be reused to control weeds in places where weeds are not desired.

Activity: Bring to class a clump of weeds potted in soil. Place newspaper completely over them. Observe intermittently to see what happens to the plants although they are properly watered. The students should observe that the plants will lose their color and eventually die. Discuss why this happens.

Discuss that people could use this method to control weeds in flowerbeds and other planted areas. Holes can be cut or left for the desired plants. A covering of rock, gravel, bark dust, bark chips or clippings and mulch will hold it in place.

Basic 15

Objective: When given a variety of materials, the student will decorate used cans and list several ways the decorated cans can be used at school or at home.

Activity: Have students bring used cans of all sizes to school. Using decorating materials, refurbish the cans. Have the class make a list of ways they might use the cans at school or at home. Discuss that you are recycling. How are you helping to reduce potential litter? Have each student share how his can will be used.

Suggested Materials: yarn, cord or string; contact paper; art paper; gift wrap; cloth; colored comics from newspaper; used greeting cards; paint; etc.

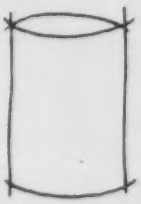
Extending 15a

Subject Content Areas: Art, Math, Language Arts

Activity: Have each student make a picture book recording the step-by-step activities in decorating a can for reuse. Have the final picture show how the can will be used.

Have the students figure how many pages they will need, what size the paper will be, how much time they spend on the activity and how to use curved lines and straight lines to draw the can.

During Reading have the students tape record a story to go with the books. Listen to the story to see if each step was covered. Revise and re-tape if necessary.



Culminating

Objective: The student will start a recycling center in the classroom.

Activity: Develop a waste paper recycling box for the classroom.

Have the students decorate a big box and label it "Recycling Box". Have the students put all their waste paper in it. When the box is full, separate the paper into these groups:

a. art paper - colored
b. lined papers
c. newsprint
d. paper with crayon marks

Tie each group into a bundle. Call your paper recycling center and ask which paper group they will take. Take the paper to the recycling center when you have enough bundles.

see Card 16a.....

Extending 16a

Continued...

Reuse the art paper scraps for additional art projects.

Have students make up class rules for the use of the recycling center. Decide what happens when the rules are broken. Elect a student recycling manager.

Have your students share their recycling ideas with other grades.

If you do not have a recycling center near you, decide what to do with your paper. What are your alternatives? Explore! Make a decision based on your choices. If you decide to have the custodian dispose of it, ask him/her to come and tell you what happens to it. Is that the best solution? If not, why?

Extending 16b

Activity: See the film: "Litter Monster" (Higgins, 1970) 16 min., Color for primary

Construction of a litter monster by young people focuses attention on the need for litter prevention. Explains how litter destroys beauty and how clean-up activities could be utilized.

Make a classroom litter monster to hold recyclable items such as paper, bottles, cans, etc. Recycle the items.

Make Litter Monster bags. Have students design big shopping bags with handles. Have the students use the bags for their recycling projects at home. When they are full they can be taken to a recycling center.

Extending 17

Objective: The student will be able to tell orally, write and/or draw the meaning of the word "recycling".

Activity: After the students have completed activity cards 2, 4-16, 18 and/or 23 have them define "recycling". Write the definitions on butcher paper for display.

The students could draw and color illustrations for the definition poster.

Basic 18

Objective: Given a paper bag the student will reuse it for several consecutive days.

Activity: Practice recycling and conservation. Have the students bring a paper bag to school. (You may wish to decorate them.) Discuss all the ways the bags could be used. (Examples: lunch sack, carry papers home, bring items to share, store crayons, etc.)

Have a contest to see who can keep the same bag in use the longest. Keep a chart. Who found the most uses?

Stress the point that this activity may be called recycling. Discuss how reusing products can save money and reduce litter.

Extending 19

Objective: The student will be able to make a decision and justify his position concerning a recycling problem.

Activity: Pose a problem to the class, asking each to be ready to explain his solution and the reason he chose that solution.

Situation: A child, drinking a bottle of pop, was riding a bike home from the store. When the pop was gone, the bottle was tossed into the ditch at the side of the road. You saw this happen. What will you do?

a. Pick up the bottle and return it for a refund.
b. Call the child back to pick it up and return it to the store.
c. Tell the parents what happened.
d. Leave it there and ignore it.
e. OR.....

What would a policeman do?

Extending 20

Objective: The student will be able to express his opinion about recycling problems.

Activity: Initiate discussion with these questions;

1. Should people be required to recycle products such as bottles, newspapers and cans? Why? OR Why not?
2. What happens to the environment when people do not recycle?
3. What happens to products that are recycled?

Basic 21

Objective: The student will be able to argue convincingly to support his position.

Activity: Show your students an object such as a paper clip, bottle cap or half-used pencil. Try to convince the class that the object is worthless to anyone. Encourage the students to try to convince you that it has value and could be used or reused for some purpose.

Extending 21a

Objective: The student will be able to present a convincing position statement.

Activity: Have the students bring something to class that they think is totally worthless to anyone. Next, have the student prove that it is worthless. Have class discussion.

a. Was it easy to find a worthless item?
b. Where did you find it?
c. Could it be reused for anything?
d. Should it have been made in the first place?
e. What will you do with it now?

Basic 22

Objective: Students will become aware of conservation practices.

Activity: Show the class a newspaper. Have them tell you all the things the newspaper can be used for. As you list them on the board, ask them to give reasons for their answers.

Next try a glass bottle
plastic container
card board container
paper sack
egg carton ..... etc.

Can these products be reused many times rather than thrown away?

Basic 23

Activity: Have the class read the "Poppy Pop Bottle" story. Discuss these questions with your students:

a. Why do you think people recycle pop bottles?
b. What might happen to all the pop bottles if they were not recycled? (litter, broken glass, etc.)
c. What reasons do you think there are for putting pop in glass bottles rather than material like milk cartons?
d. Do you think there should be laws telling people and factories to recycle pop bottles? Why? OR Why not?
e. Are there other ways to recycle pop bottles?

Have the students act out the "Poppy" story. They could make pop bottle masks or puppets.

Have them make their own picture books about a pop bottle and recycling.

Basic 24

Activity: Have the class read the story, "Mrs. Newspaper". Discuss these questions with the Students:

a. Why do you think people recycle newspapers?
b. What might happen if newspapers were not recycled?
c. Do you think there should be laws telling people and factories to recycle newspapers? Why? OR Why not?
d. Can you think of other ways to recycle newspapers?

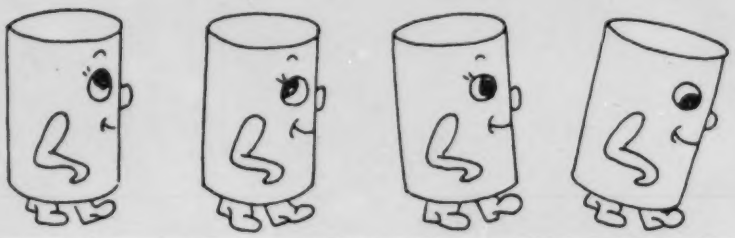
Act out the story of "Mrs. Newspaper". Dress up in newspaper costumes and act out the recycling process.

Have the students make their own picture books about newspapers and recycling.

Basic 25

Activity: Have the students read "Jan the Can".
Discuss these questions with the class:

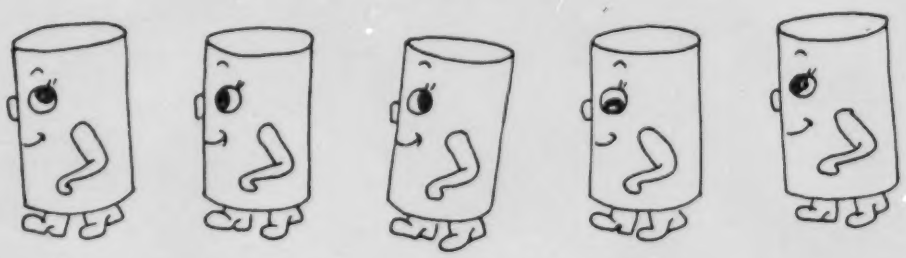
a. Why do you think people recycle cans?
b. What might happen if all the cans were never recycled?
c. Do you think there should be laws forcing people and businesses to recycle cans?
d. Can you think of more ways to recycle cans?



Extending 25a

Activities: Have the class act out the story of "Jan the Can. Make costumes as necessary to your method.

Have the students make their own picture books to illustrate the recycling of cans.



Energy Activity No. 40

Title: Energy Conservation Posters (Family Contest)

Concept: Societal actions influence, extend or exhaust available energy.

Objective: The students will have the opportunity to enter into a competition in which families will try to conserve energy.

Subject Area: Math, Art, Language Arts

Level: 4-6 7-9

Time Involved: 3 - 30-45 minute sessions

Materials needed: Poster paper or construction paper, crayons, paint, electric meters, and magic markers

Procedure:

1. Pose to the students the need for families to conserve energy in each household. Suggest a campaign so that each student's family participate in a contest to conserve energy. Ask each student to read their electric meter daily for 5 days to find the average consumed each day. Multiply it by 30 to get the projected usage for one month.

   Draft a letter to parents to ask their participation in the contest. Determine the greatest users and most wasted appliances. Every campaign needs posters. Suggest that posters be made and attached to appliances as reminders of the campaign.

2. Create posters to be placed on appliances. Determine criteria for poster contest judging. At end of period judge posters.

3. Begin contest on set date. Everyone brings in meter reading on the initial day and posts it. After 30 days, compare results to projected outcome.

Energy Activity No. 40
(continued)

Determine the percentage used by the percentage predicted. Let the percentage determine the winning families. Write letters of congratulations to the families to give recognition or have a "Jones" family honor day, etc.

Energy Activity No. 41

Title: "Bottles or Cans?"

Concept: Energy, its production, use, and conservation are essential in the maintenance of our society as we know it.

Objective: To understand the energy savings related to using returnable bottles.

Subject Area:	**Level:**	**Time involved:**
Math, Social Studies	4-6 7-9	1 hour

Materials needed:

Procedure:

1. Review with the class the fact that energy can be saved by using returnable bottles instead of throw-away soft drink bottles or cans. The amount of energy saved according to the reference cited above is paraphrased as follows:

   "The purchase of a six-pack of soft drinks in returnable bottles instead of no-deposit, no-return containers will save the energy equivalent of 1 1/2 pints of gasoline. The saving of 1 1/2 pints of gasoline can take the average family car about 2 1/2 miles. Additionally when the empty bottles are returned for the 30-cent deposit the six-pack purchase will have cost 18 cents less than for throwaways.

2. Involve the class in some mathematical computations. How much energy equivalent in gasoline will each family represented in the class save if they purchase one or two six-packs of returnable bottles each week for one year? How many miles of automobile travel are possible? How much money is saved? What are the total amounts for the entire class?

Energy Activity No. 41
(continued)

3. Since this appears to be such an easy way to save energy why do we still find so many persons buying beverages in throw away containers? What, if anything, might or should the government or people do about this matter?

Energy Activity No. 42

Title: "Meter Readers"

Concept: Energy, its production, use, and conservation are essential in the maintenance of our society as we know it.

Objective: To acquaint the student with the method of reading an electric meter and interpreting an electric service billing.

Subject Area:	**Level:**	**Time Involved:**
Math, Science, Social Studies	Middle School	Variable

Materials needed:

Procedure:

1. The teacher will distribute copies of the accompanying material to all students and with the aid of a master copy on the overhead projector, guide them through the steps in reading the electric meter. Be sure that the students understand the procedure by changing the positions of the dials and asking for new readings. (A large cardboard type of chart containing meters and movable dials could be constructed by one of the students and used for individual practice.)

2. Following the same basic procedure, the teacher guides the student through a reading and explanation of the indicated items on the electric service bill, giving special attention to the figures which indicate the kilowatt hours used.

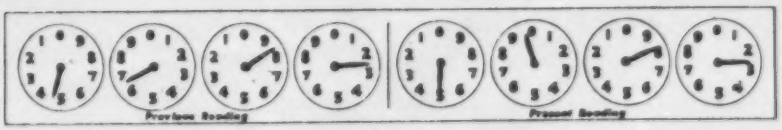
3. Several costs of operation of appliances in the home can be worked out using the rate chart included in this activity. It may be a good idea to check your local power company to determine if the rates are substantially different from those included here.

4. Follow up: Students record daily kilowatt readings (at the same time each day) for one month, recording these data in a simple journal which also includes some observations about the temperature, appliance use, and other pertinent factors which might affect the amount of use of appliances.

LATEST RATING SCALES - June 1975

1st 20 Kilowatt Hours	$ .021	750-1350 KWH	$ .031
20-100 KWH	.045	1350-7800 KWH	.0285
100-200 KWH	.039		
200-750 KWH	.039		

DO-IT-YOURSELF PROJECTS



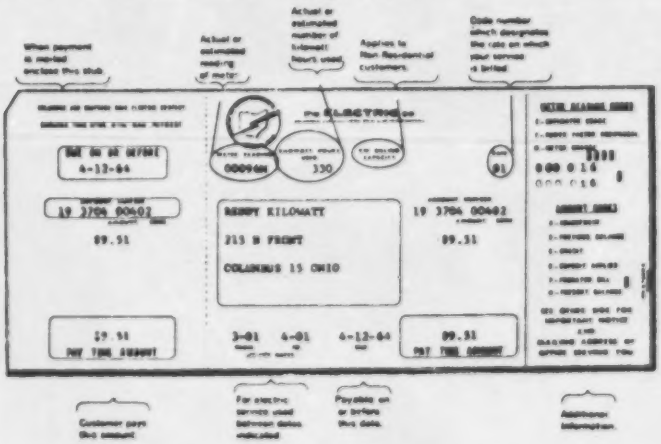
How to Read a Meter

To read an electric meter, stand directly in front of dials. Read dials from left to right. Some of the dials move in opposite directions from each other, but regardless of that, always read the smaller figure when the hands are between two numbers. For instance, in the left box above, the figures read 4682.

If the hand of the first dial appears to be directly over a number, read the next dial to determine whether or not the hand has passed zero. If it hasn't reached zero, use the next lower number on the first dial. The reading on the dials in the right box should be 4982.

The figures on the dials represent kilowatt-hours which signify the number of kilowatts flowing through your meter multiplied by the length of time.

How to Determine Amount of Electricity Used



The reproduction of the above bill is similar to the one which comes to your home monthly. The figure circled at the top of the bill is the present meter reading. If you subtract the corresponding reading in the previous bill from the present reading you get the number of kilowatt-hours (330) of electricity used between the present and previous readings.

Energy Activity No. 43

Title: Solar Cell Efficiency

Concept: Presently, most of our energy requirements are met thru using fossil fuels. However, there are other alternative sources of energy such as solar, wind, fission, fusion, hydrogen, hydro, and geothermal which must be considered and developed.

Objective: To determine the energy generated by a solar cell.

Subject Area: Science

Level: Middle School

Time involved: 1 hour

Materials needed: Voltmeter, ammeter, solar cell

Procedure:

1. On a board, connect the solar cell to the voltmeter and ammeter. Then have students take this instrument outside to experiment. Ask the students to determine the best angle of the solar cell to get maximum volt and ampere readings. Record this data.

2. Back in the classroom, have students determine the wattage by multiplying volts by amps. From this data, convert wattage to number of kilowatts.

3. How does the wattage produced by the solar cell compare with the wattage required by some household appliances? How does the number of kilowatts produced compare with a typical family's monthly consumption? Could solar cells be used to power a city? A home? How much surface area of solar cells would be required to produce the power needed for a home? What factors affect the efficiency of a solar cell?

Energy Activity No. 44

Title: Peanut Butter and Jelly Sandwich

Concept: All living things and natural processes require energy.

Objective: The students will learn that it takes many different energy sources to produce a peanut butter and jelly sandwich.

Subject Area:	**Level:**	**Time involved:**
Social Studies, Health	Middle School	1 hour

Materials needed: Peanut butter, jelly, bread, knife, large pieces of paper

Procedure:

1. Divide the class into small groups.
2. Have each group member make a peanut butter and jelly sandwich.
3. Each group should list the different forms of energy required to be able to prepare the sandwich. Remember that the sun is the original energy source. (The teacher could suggest to start with the bread first and continue to trace according to the order they used the materials.)
   Example: sun - grain - harvesting - transporting - production - transporting - marketing - purchasing - etc.
   There are many spin-offs, so most suggestions can be accepted.
4. Give each group a large piece of paper and have them list or illustrate their conclusions.
5. Share information with the entire class.
6. Eat your sandwich.

Energy Activity No. 45

Title: "How Do You Travel?"

Concept: Some human technologies and activities use more energy than others.

Objective: The student will know and work with the basic units of energy measure.

Subject Area: Math, Social Studies

Level: Middle School

Time involved: 2-3 class periods

Materials needed:

Procedure:

1. The student should contact the airline, train, and bus line for the necessary information:
   a. You will need to get the following data for each form of transportation:
      1. miles per gallon of fuel
      2. average number of passengers
      3. divide miles per gallon by number of passengers
   b. Information concerning the automobile should be based on average which the students can compile using family car averages.
2. Contrast the energy units required per passenger mile for each major form of transportation.
3. Discuss implications of these differences with respect to energy conservation, individual convenience and habits.

Energy Activity No. 46

Title: "How Many Miles Per Gallon?"

Concept: There are many ways to conserve energy.

Objective: Student will be able to determine mileage of a car.

Subject Area: Math	**Level:** Middle School	**Time involved:** Home Activity

Materials needed:

Procedure:

1. Choose a service station which will be convenient to use for two fill-ups. Choose the same pump to use each time and make sure your car is level.
2. Get a fill-up; make sure the tank is filled to the top. Record the mileage on the speedometer.
3. When the gas tank is at least below half full, go back to the same place and under the same circumstances, fill the gas tank.
4. Record the mileage and the amount of gas used in gallons. Find the difference in mileage and divide by the number of gallons purchased in the second fill-up.
5. List as many variables as you can that might affect the mileage of your car. Example: in town driving vs. driving on a trip, rapid acceleration vs. smooth take off, car before tune-up vs. car after tune-up.

Energy Activity No. 47

Title: Driving Record

Concept: There are many ways to conserve energy.

Objective: Student will develop a chart which will show the number of miles driven by his family each week.

Subject Area:	**Level:**	**Time Involved:**
Math, Social Studies	Middle School	Home Activity

Materials needed:

Procedure:

1. Make a driving chart for each driver in your family and ask them to keep it for a week. Record the purpose and mileage of each trip.
2. At the end of the week, find total miles driven by each driver and discuss a plan with your family that will reduce this number of miles. Each driver must agree to the plan.
3. Keep the same records for the next week following your plan.
4. Analyze your results. Find the saving in number of miles driven, gallons of gasoline saved and amount of money saved. Remember that each car will get different mileage.

Energy Activity No. 48

Title: Energy Survey

Concept: Every decision made involving energy affects standards of living.

Objective: By means of a survey, students will determine where in the community energy is being wasted and make an effort to bring about a change.

Subject Area:	**Level:**	**Time involved:**
Social Studies, Language Arts, Speech	Middle School	2 or 3 class periods

Materials needed:

Procedure:

1. Each student keeps an energy notebook listing places in the community where energy is being wasted and the address of the place.

2. Compile a class list of all the places you have found wasting energy.

3. After 3 or more class members have confirmed each energy waster on the list, have a class debate to decide if that use of energy is really wasteful.

4. After the debate and a class vote, write letters to the three addresses considered to be wasting the most energy. Explain in your letter the national need to conserve energy, the class project you have undertaken, and the way you think energy is being wasted. Try to be helpful and suggest ways that the same job can be done with less energy.

Optional Activities

1. Set up a display showing ways to save energy that could be set up in the library or in a store window.

Energy Activity No. 48
(continued)

2. Write an article for the local paper on the energy conservation projects your class is doing.

3. Interview everyone in your neighborhood to find the ways they are saving energy.

Energy Activity No. 49

Title: "How Can I Save Heat in My Home?"

Concept: There are many ways to conserve energy.

Objective: The student will be aware of the essential need for conservation of energy in the maintenance of our society.

Subject Area: Science, Social Studies

Level: Middle School

Time involved: 30-45 minutes

Materials needed: Pencil, paper

Procedure:

1. Simulation: It is a very cold winter and there is a critical shortage of fuel. The government has reduced each family's fuel allocation by 25 percent.
2. Make a list of ways to deal with the problem.
3. What can each person's family do?
4. What could the father do? the mother? the children?
5. How can they still be comfortable if they reduce the temperature in their home?
6. List ways to adapt to new environmental conditions.

Energy Activity No. 50

Title: "Which House Would You Want?"

Concept: There are many ways to conserve energy.

Objective: Compare types of building materials and insulation types and be able to make value judgments as to most desirable.

Subject Area: Math, Science

Level: Middle School

Time involved: 1 class period per day

Materials needed: Wood, paint, brushes, nails, hammer, insulation, plastic, newspaper, shingle, styrofoam

Procedure:

1. Build a number of tiny "mini-houses."
2. Determine variables you wish to study and vary house as needed.
   a. types of insulation
   b. types of materials in house itself
   c. number of windows
   d. building style
   e. different colors paint on surfaces
   f. varied thicknesses
3. Make temperature checks inside each house at planned intervals, keep record of data.
4. Compare and make value judgment as to one most favorable, "energy-wise" house.

Energy Activity No. 51

Title: "How Can I Save Water?"

Concept: There are many ways to conserve energy.

Objective: The student will be able to determine the amount of water that could be saved by showering rather than taking a bath.

Subject Area: Science, Math

Level: Middle School

Time involved: Take home activity

Materials needed: Bathtub, shower, ruler, tub marker (tape), graph paper, liter (gallon container, i.e. milk jug)

Procedure:

1. Take a normal shower with tub drain closed, measure water level.
2. Next day take a normal bath; measure the water level.
3. Measure volume in liters and compare.
4. Compile data brought by all students.
5. Graph each set of data using bar graph and/or line graph.
6. Average the amount used in each case using class data.
7. List ways of reusing water to additionally conserve.
8. Determine the dimensions of tub, compute volume used in gallons. Convert to liters. Compare computed volume with measured volume.
9. Which method of determining volume was the easiest?

Energy Activity No. 52

Title: "Energy for Fun"

Concept: Every decision made involving energy affects standards of living.

Objective: Students will become aware of the relationship between standard of living and energy use.

Subject Area: Social Studies

Level: Middle School

Time involved: 1 - 50 minute period

Materials needed:

Procedure:

1. Each student will make a list of five leisure activities he enjoys.
2. He will rank the activities from the most enjoyable to the least enjoyable, using this scale: 3 - most enjoyable activity; 2 - second most enjoyable activity; 1 - third most enjoyable activity; 0 - activity he could do without.
3. The student will place a dollar sign next to each activity that costs money each time it is performed.
4. The student will assign an energy point value to each activity. Scale: 3 - consumes major amount of energy; 2 - consumes moderate amount of energy; 1 - consumes very little energy; 0 - consumes no energy.
5. The student will assign a frequency of use point value to each activity. Scale: 3 - activity performed frequently; 2 - activity performed occasionally; 1 - activity performed seldom.
6. The students will consider what they have learned about themselves as result of this exercise.

Energy Activity No. 52
(continued)

7. The teacher will explain to the class that a severe energy crisis has occurred and all people must conserve at least 50 percent of their energy use. Students will be advised to choose which activities they will eliminate or curtail in order to cut their energy consumption 50 percent.

8. The teacher will ask the students the following questions:

   a. Are you willing to reduce your energy consumption by 50 percent? Why/why not?
   b. How did you conserve energy? Which activities did you reduce?
   c. What types of activities can we do that are fun and do not require nonrenewable energy resources (gas, oil, electricity)?

Energy Activity No. 53

Title: "I'm Wearing Energy!"

Concept: All industrial processes make use of several forms of energy.

Objective: Students will identify sources of energy used to provide clothing.

Subject Area: Science, Social Studies, Home Economics

Level: Middle School

Time involved: 1 class period, outside research

Materials needed:

Procedure:

1. Each student makes list of all clothing items being worn. Compile master list. Find labels and learn what items are made of. List all kinds of fabrics and materials which are represented.

2. Research each fabric or material and find what it is made of. Record what kind of energy is used in its production. Make energy chain for each item, making one link per kind of energy used.

   sun-tractor-cotton-harvest-process-weaving-sewing

3. Value judgment

   a. Which materials require more energy in production?
   b. Which should you wear to conserve energy?
   c. List jobs involved in clothing production.

4. Design of the future: What new jobs can you create to help with future clothing design, production, recycling?

Energy Activity No. 54

Title: "Nuclear Science Careers"

Concept: Employment opportunities are created or destroyed in the evolution of conversion technologies.

Objective: Students will be able to identify career opportunities and educational requirements in the field of nuclear science.

Subject Area: Social Studies, Language Arts

Level: Middle School

Time involved: Variable

Materials needed:

Procedure:

1. The students will write for information related to career opportunities in nuclear science. To assure response to requests, attach stamped, self-addressed envelopes.

   a. Society of Nuclear Medical Technologists
      P. O. Box 284
      Arlington Heights, Illinois 60006

   b. National Science Foundation
      1800 G. Street, NW
      Washington, D. C. 20550

   c. The American Society of Radiologic Technologists
      645 North Michigan Avenue
      Room 620
      Chicago, Illinois 60617

d. Careers (Career Publication)
Box 135
Largo, Florida 33540

e. Nation Center for Information on Careers in Education
1607 New Hampshire Avenue, NW
Washington, D. C. 20007

2. After students receive the information, they will identify the career which interests them most. They will list in order the educational and other preparatory needs to meet the requirements.

Optional Activities

1. Make chart of careers and their descriptions.

2. Assemble career titles into bingo game.

3. Make bulletin board of collage depicting careers.

4. Guest speaker.

Energy Activity No. 55

Title: "This One" or "That One"

Concept: Each form of energy can be used in many ways.

Objective: The student will be able to discuss six alternative ways of doing jobs.

Subject Area: Science, Home Economics, Social Studies

Level: Middle School

Time involved: 1 class period

Materials needed: Pencil, paper

Procedure:

1. Develop with the class a list of 15-20 pairs of alternative ways of doing things commonly found in our way of life, such as the following:

   a. dishwasher vs. doing dishes in sink
   b. fan vs. air conditioner
   c. power mower vs. hand mower
   d. electric razor vs. razor blade
   e. bath vs. shower
   f. auto vs. bicycle
   g. motorboat vs. canoe or sailboat

2. Have students, working in pairs, select one of the alternatives and compare/contrast amounts of energy used and benefits received from the one selected. Also identify forms of energy used by the pairs.

Optional Activity

Make a collage using either all hand powered or electric powered aids.

Energy Activity No. 56

Title: "Energy Time Capsules"

Concept: Various energy sources have differing impacts on environment.

Objective: Become aware of impact of packaging waste on our environment.

Subject Area: Science, History

Level: Middle School

Time involved: 1 hour

Materials needed: Plastic wrap, paper, styrofoam meat tray, foil, shovel, markers, stones

Procedure:

1. Collect 3 or 4 types of packaging.
2. Choose place to bury each type material near school where it won't be disturbed.
3. Label spots carefully for locating later.
4. Dig up items at monthly intervals and note changes taking place.
5. Make careful monthly records of changes.
6. At end of sixth month, are there any items not changed?
7. Research definitions of biodegradable and decompose.
8. Why is decomposition important? How does it help us?
9. Which forms of packaging are favorable and unfavorable (energy-wise)?

Energy Activity No. 57

Title: "It's in the Bag"

Concept: Social, economic, and political pressures influence effective and economical use of energy.

Objective: Student will be able to identify many sources of energy waste due to overpackaging in America's food system.

Subject Area: Science, Social Studies	**Level:** Middle School	**Time involved:** Variable

Materials needed: Collection of packaging materials

Procedure:

1. Collect and bring to class all the boxes, wrappings, trays, foil, plastic film, etc., used to supply one week's groceries.
2. Discuss ways these are wasteful.
3. List ways to reduce packaging or possibility of recycling.
4. Conduct adult interview.
   a. Are you concerned about amount of packaging you throw away?
   b. Do you think a simple system would save energy and money?
   c. Would you prefer to have less packaging for your products?
5. Discuss results of interview and compile attitude summary.
6. Write letter to local supermarkets relating concerns, recommendations.
7. Have kids write a news release. Send to local paper telling what they've done.

Energy Activity No. 58

Title: "Crisis"

Concept: Every decision made involving energy affects standards of living.

Objective: Students will be able to consider priorities for energy consumption.

Subject Area: Social Studies

Level: Middle School

Time involved: 2 - 50 minute periods

Materials needed:

Procedure:

Students will consider the choices to be made if a large scale natural disaster were to strike the United States, severely impairing electric power sources.

1. The teacher will divide the class into small groups representing various groups such as:

   a. city government
   b. factory workers
   c. consumers
   d. service industries
   e. school employees

2. Each group will meet and list its energy needs and priorities in written form. One representative from each group will report on his group's decisions for the community to the class. The class as a group will determine priorities for the entire community as to who will get the available power and to what degree.

Energy Activity No. 58
(continued)

Optional Activity

The teacher will ask students how they would react in a personal situation such as:

A recent violent storm has damaged local electrical power sources so that electricity in the area must be rationed in private homes to allow adequate supplies to local hospitals and other users.

The teacher might ask questions such as:

a. If you knew that the air conditioner and other appliances continued to be used in your best friend's home how would you react?
b. What would you do about it?
c. What should you do about it?

Energy Activity No. 59

Title: Which Do You Drive?

Concept: Every decision made involving energy affects standards of living.

Objective: The student will be aware of public attitudes toward energy shortage.

Subject Area: Math, Social Studies

Level: Middle School

Time involved: 3-4 class periods

Materials needed:

Procedure:

1. Develop some means of categorizing cars (i.e., small, medium, large, or 15 mpg, between 15 mpg and 22 mpg).
2. Call all car dealers in town and make a survey of how many cars have been sold this year in each category.
3. Combine the results by means of a bar graph.
4. Develop a survey for individuals which will determine:
   a. The kind of car they have
   b. Their rationale for what they drive
   c. Their attitude toward oil supplies
   d. Their predictions for the energy situation in this country in the future
5. Analyze results of survey. See if:
   a. Individuals' replies agree with survey of cars,
   b. There is any difference between attitudes of adults and teenagers.

Energy Activity No. 60

Title: Reducing Home Kilowatt Hours

Concept: There are many ways to conserve energy.

Objective: The student will compile itemized list of kilowatt hour usage in his home.

Subject Area: Math, Social Studies

Level: Middle School

Time involved: Homework

Materials needed: Pencil, paper

Procedure:

1. Through discussion, students develop a list of all appliances in home which consume electricity. Use this list to make a data table such as follows:

Appliance	Watts	Hrs. Used	Watts X Hrs.	$\frac{\text{Watt Hrs.}}{1000}$ (KWH)

2. Each student completes table for the appliances in his home for one 24 hour period and computes total KWH.

3. Compile class results onto a composite showing results. Find average KWH used for families of 2, 3, 4, etc. Graph these averages.

4. Based on discussion with parents, plan priorities for usage.

5. Predict and compute KWH savings.

Energy Activity No. 60
(continued)

6. Attempt to implement the plan for 24 hours. Repeat inventory if necessary.

7. Develop graphs, charts, etc., showing the original consumptions, the predicted savings, the actual savings, and a projection for a neighborhood or community of a given size.

Energy Activity No. 61

Title: "What's Important to You?"

Concept: Every decision made involving energy affects standards of living.

Objective: The students will become aware of the priorities in his lifestyle.

Subject Area: Social Studies

Level: Middle School

Time involved: 45 minutes

Materials needed: Pencil, paper

Procedure:

1. List all of the appliances you have in your home.
2. Place them in the following chart according to importance to you.

Luxury	Convenience	Necessity

*Define luxury, convenience, necessity.

3. Are there any items in the "necessity" column that were once considered either "luxury" or convenience items?
4. If every family could only have 10 appliances in their homes, which 10 would you choose?
5. Compile the data by putting a chart on the board which reflects the attitudes of the class. Try to get an agreement on 10 items which are most necessary.

Energy Activity No. 62

Title: "Use It Again, Sam"

Concept: There are many ways to conserve energy.

Objective: Recycling newspaper in your own class.

Subject Area: Science

Level: Middle School

Time involved: 2 days

Materials needed: Old newspaper, mixing bowl, egg beater, wood block, a square of window screen (3-4 inches), plastic sandwich bag, wallpaper paste or corn starch, water, tablespoon

Procedure:

1. Fill bowl 1/4 full of H_2O.
2. Tear 1/2 of a newspaper page into pieces.
3. Place pieces in bowl and let soak 1 hour.
4. After thoroughly soaking, beat with egg beater. This will break into fibers.
5. When beaten, paper should be creamy like wood pulp.
6. Dissolve 2 heaping tablespoons of paste in 1 pint of water.
7. Pour into and stir in the pulp.
8. Hold screen flat and lower into pulp. Repeat till you accumulate layer of pulp 1/10 of an inch thick.
9. Set screen on a newspaper and place plastic bag over it.

10. Press down with wood block gently, then with pressure.
11. Water will filter out through screen onto newspaper.
12. Allow fibers to dry for 24 hours.
13. Peel the fibers (then the paper) from the screen.

Optional Activity

1. Name all the things you can make from recycled paper.
2. Do you have a recycling plant in your town?
3. How can we help recycle paper?
4. Name other things we can recycle.

Energy Activity No. 63

Title: "Is That Really What I Eat?"

Concept: All forms of food energy originated with the sun.

Objective: The student will construct a list of cafeteria foods in their original form and trace each back to its original energy source - the sun.

Subject Area: Science, Home Economics, Agriculture

Level: 7-12

Time involved: 20-30 minutes

Materials needed:

Procedure:

1. Have students list all the food the school cafeteria served for lunch on a given day.

2. Name each food item by its original form in nature. A chart may be useful as shown below:

Roast beef -	cooked muscle tissue of a cow	- grass	- sun

Optional Activity

Have students list in order the foods that require the least amount of energy to process for food consumption to those foods that require the most energy to process.

Energy Activity No. 64

Title: Residential Energy Checklist

Concept: Checklists can be used as a handy guide to systematically search for residential energy waste and potentials for conservation.

Objective: To provide an easy and quick scan of the moe to reveal possible sources of energy waste and potentials for energy conservation.

Subject Area: All

Level: 7-12

Time involved: Homework

Materials needed:

Procedure:

The following checklist can be used by you (the student), your parents, friends, and relatives as a handy guide to systematically search for residential energy waste and potentials for conservation. The checklist does not attempt to quantify the energy loss, nor estimate the cost to alleviate the problems. In some cases it might not be practical to try to eliminate the waste, but rather to reduce it or its impact. You should refer to the specific areas in the text for further information.

RESIDENTIAL ENERGY CHECKLIST

House: The Shell	Yes	No
1. Are plants properly located around the house to provide a break against wind and shade against unwanted sun?		
2. Are drapes and furniture located so they do not obstruct heating, air-conditioning or ventilation?		

Energy Activity No. 64
(continued)

	Yes	No
3. Are draperies insulated?		
4. Do draperies fit snugly around the window?		
5. Are exterior house doors closed quickly after use?		
6. Are lights and appliances turned off after use?		
7. Do you have storm windows and doors?		
8. Are all doors and windows properly caulked and weatherstripped?		
9. Are draperies and shades closed at night and on cloudy, windy days during the heating season?		
10. Are draperies opened to admit sunlight on sunny days in the heating season?		
11. Are draperies and shades closed on sunny days during the cooling season?		
12. Is the attic ventilated?		
13. Is the attic insulated to 6-8"?		
14. Are the walls insulated?		
15. Do floors exposed to unheated or cooled air have from 2-3 1/2" of insulation?		
16. Is the fireplace damper closed when not in use?		
17. Is the den, gameroom or family room oriented to the south?		
18. Is the house shaded from the western sun?		
19. Does your home have window area equivalent to 10 percent or less of its square footage?		
20. Is your home sealed from drafts? Is it free from cracks and holes?		
21. Does your home have wall-to-wall carpeting?		
22. Does your home have fluorescent lighting where appropriate?		
23. Do all windows have drapery, shades, blinds, shutters or other covering?		

Energy Activity No. 64
(continued)

Environmental Control	Yes	No
24. Are ducts, radiators or air-conditioners closed off in unused rooms or closets?		
25. Are hot water pipes insulated in unheated and uncooled spaces?		
26. Are air ducts insulated in unheated and uncooled spaces?		
27. Is the thermostat set at 68°F or below during the heating season?		
28. Is the thermostat set at 78°F or above during the cooling season?		
29. Are heating and cooling filters clean?		
30. Is the thermostat turned back at night?		
31. Are windows and doors tightly closed while mechanically heating or cooling?		
32. Is an attic fan used in the summer?		
33. Do thermostats indicate correct temperature settings?		
34. Is an outside air-conditing unit located on the shady (north) side of the house?		
35. Is the water heater insulated?		
36. Is the water heater temperature setting at 140°F or less?		
37. Is the air-conditiong unit properly sized for your needs?		
38. Do you have a heat pump?		
39. Do you use natural ventilation as much as possible?		
40. Are radiators and other heating or cooling equipment clean and dust free?		
41. Is the water heater located in a heated space?		

Energy Activity No. 64
(continued)

	Yes	No
Housing Selection		
42. If you live in an apartment, is it an "inside" apartment?		
43. If you live in a mobile home, does it have a "skirt?"		
44. If you live in an older home, have its plumbing, wiring, insulation and chimneys been checked by "experts"?		
Food		
45. Is the frost on the refrigerator and freezer less than 1/4 inch thick?		
46. Is the refrigerator set at 40°F?		
47. Is the freezer set at 10°F?		
48. Are gaskets around refrigerators and freezers tight?		
49. Is the oven used to bake more than one food at a time?		
50. Is the gasket around ovens tight?		
51. Are frozen foods thawed completely before cooking?		
52. Is the cooking range turned off immediately after use?		
53. Are dishes washed only when there is a full load?		
54. Are dishes allowed to air dry?		
55. Are appliances clean and dust free (particularly cooling coils)?		
56. Is the oven never used as a dryer or heater?		
57. Are flat bottom pots and pans used?		
58. Is a timer used to avoid over-cooking?		
59. Are pots covered during cooking?		
60. Is as little water used as possible during cooking?		
61. Is the heated dry cycle on the dishwasher not used?		

Energy Activity No. 64
(continued)

	Yes	No
Clothing		
62. Does your family dress warmer in cool weather to avoid mechanical heating?		
63. Does your family dress cooler in warm weather to avoid mechanical cooling?		
64. Are clothes washed only when there is a full load?		
65. When washing, is cold or warm water used when possible?		
66. Are clothes line dried when possible?		
67. Are most of your family's clothes wash-and-wear, permanent press to avoid dry cleaning and ironing?		
68. Are clothes always rinsed with cold water?		
69. Is the washer located near the water heater?		
70. Is the dryer lint screen cleaned after each load?		
Personal Care		
71. Do the members of your family take short showers or use only small amounts of water for tub baths?		
72. Are all water faucets repaired and not leaking?		
73. For washing, shaving or make-up is the lavatory filled rather than allowing water to run?		
Entertainment		
74. Are entertainment devices turned off when not in use?		
75. Do members of your family try to entertain themselves rather than rely on devices?		

-- If you answered with 65 or more yes's, you are truly an energy conserver and will make a good conservation advocate.

-- If you answered with 55 to 65 yes's, you are energy conscious but lack will-power or drive.

-- If you answered with 45 to 54 yes's, you are wasting energy but with minor changes could make a conserver.

-- If you answered with 35 to 44 yes's, you are an energy waster and should make an all-out effort to reform!

-- If you answered with less than 35 yes's, you are making an effort to waste energy and should consider the long range and immediate effects!!

Suggestions:

1. Distribute these checklists school-wide.
2. Try a before and after approach to using the checklist. Check before your conserving effort and after.
3. Survey students to see if their families are generally conservative or not.

Energy Activity No. 65

Title: Energy Attitude Survey

Concept: Attitudes change after energy education.

Objective: Given a preaccessment and postaccessment survey on energy, the student's attitudes will change.

Subject Area: Science, Social Studies

Level: 7-12

Time involved: 20 minutes

Materials needed:

Procedure:

Use the following Energy Attitudes Survey as an introduction and a conclusion to your energy activities to observe attitudes for change.

ENERGY ATTITUDE SURVEY

1. Do you believe there is an energy shortage? ___yes ___no ___don't know
2. Do you believe you have been given a realistic picture of the energy situation facing the United States? ___yes ___no ___don't know
3. Do you believe most Americans are energy "wasters"? ___yes ___no ___don't know
4. Do you believe most Americans are energy "conservers"? ___yes ___no ___don't know
5. Do you believe Americans are "spoiled", self-indulgent and reluctant to take responsibility for the future? ___yes ___no ___don't know

Energy Activity No. 65
(continued)

6. Do you believe it is the responsibility of every U.S. citizen to conserve energy voluntarily? ___yes ___no ___don't know

7. Do you believe Americans will conserve energy only when government controls are imposed? ___yes ___no ___don't know

8. Would you be willing to reduce your standard of living to conserve energy? ___yes ___no ___don't know

9. Do you believe you as an individual can make an impact on energy consumption? ___yes ___no ___don't know

10. Would you conserve energy to save money? ___yes ___no ___don't know

11. Do you think the money saved is worth the inconvenience of conserving energy? ___yes ___no ___don't know

12. Do you think the energy saved is worth the inconvenience of conserving energy? ___yes ___no ___don't know

13. Do you feel technology will "bail us out" of the energy shortage? ___yes ___no ___don't know

14. Do you feel you have any input or participation in the energy usage decisions made by your family? ___yes ___no ___don't know

15. Are you going to <u>do</u> something to save energy? ___yes ___no ___don't know

ENERGY ATTITUDE TALLY

Question	Yes	Percent	No	Percent	Don't Know	Percent
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						

Find the percentages for each response. For example: if on question 1, 200 students respond; 100 say yes, 60 no and 40 don't know then the percent saying yes is $\frac{100}{200}$ or 50 percent; saying no is $\frac{60}{200}$ or 30 percent; saying don't know is $\frac{40}{200}$ or 20 percent. (You may choose to use a calculator, especially if large number of students respond.)

Suggestions:

1. Survey your class separately to see if the study of Home Economics has an effect.

2. You might print your results in the school newspaper.

3. Survey the teachers and administrators. Do their opinions differ much from the students?

Energy Activity No. 66

Title: "It's a Love Affair With a Fossil"

Concept: Everything changes; nothing stays the same.

Objective: The student will be able to identify inflationary trends and economic and environmental impact.

Subject Area: Social Studies

Level: 7-12

Time involved: 2 class periods

Materials needed: Publications

Procedure:

1. Students will search in publications such as newspapers, magazines, catalogs, for skateboard ads.

2. Ask students what their findings indicate.

   a. What changes in cost?
   b. What are the improvements? Does the plastic go faster than the wooden skateboard?
   c. Is it something you're proud to own? Is it like that of your friends?
   d. What changes have been made in materials?
   e. Are the materials used to manufacture the skateboard renewable or not?
   f. Has it taken more energy to make it now than before? If so, why is it made this way?
   g. Should energy be expended to manufacture necessities before luxuries.
   h. Now that you own a skateboard, how does it compare to other recreational products; skateboard vs. minibike thru woods?

Energy Activity No. 66
(continued)

3. Discuss several other products to get students to think about their purchases. Life span of the product, resources consumed, conserved, and/or recycled.

4. Chart information: Read an article that presents an economic perspective other than capitalism.

   NOTE: The book, Small to Beautiful, authored by E. F. Shoemaker, presents alternative economic outlook.

Energy Activity No. 67

Title: Florescent vs. Incandescent Lighting

Concept: Some human technologies and activities use more energy than others.

Objective: The students will determine the relative energy efficiency of florescent and incandescent lighting.

Subject Area: Math, Science

Level: 7-12

Time involved: 1 class period

Materials needed: 100 watt florescent bulb, 40 watt florescent bulb, 100 watt incandescent bulb, 25 watt incandescent bulb

Procedure:

1. Have the students check light bulb packages for the number of lumens produced by a bulb of each of the following:

   a. 100 watt florescent bulb
   b. 40 watt florescent bulb
   c. 100 watt incandescent bulb
   d. 25 watt incandescent bulb

2. Determine the efficiency of the bulbs in terms of lumens per watt by dividing lumens produced by the wattage of the bulb.

3. Is it more efficient to use florescent or incandescent lighting?

4. Would it be more efficient to use four 25 watt or one 100 watt incandescent bulb?

Energy Activity No. 68

Title: Housing and Energy Utilization

Concept: Standards of living have changed as energy available to heat and cool homes has changed historically.

Objective: The kind of energy in the home affects the standard of living.

Subject Area: Social Studies

Level: 7-12

Time involved: 1 week

Materials needed: Examples of insulation materials

Procedure:

During winter when snow is on, each student will do drawings of the block he/she lives on and record snow on roof or absence thereof. Have students predict which houses have proper and which houses have improper insulation.

Review sources of insulation used in the community.

Draw up a questionnaire asking neighbors to answer questions regarding insulation in their homes. Compare predictions with questionnaires.

Compare new and old neighborhoods for heat loss during snow.

Report on building codes and practices used from 1850-1977.

SUGGESTED CAREER AWARENESS ACTIVITY:

Research the careers of Buckminster Fuller, Frank Lloyd Wright, Philip Johnson. Compare their ideas on energy utilization in architecture with articles on future sources of energy.

Energy Activity No. 69

Title: "Watts Up"

Concept: Access to energy sources affect the growth of differing technological, social, governmental, economic and cultural systems.

Objective: The student will be able to compute the operating cost of different household appliances.

Subject Area: Math	**Level:** 7-12	**Time involved:** 45 minutes

Materials needed:

Procedure:

1. Compute how much it costs to operate each of these appliances for a month: washer (700 watts), dryer (5000 watts), iron (1100 watts), refrigerator (300 watts), toaster (1150 watts), coffee maker (440-1000 watts), vacuum (up to 650 watts), lamp (100 watts), air conditioner (750-1500 watts), TV (300 watts), radio (100 watts), sewing machine (75 watts).

2. To compute how much it costs to operate those appliances listed above, you must know three things.

   a. Wattage of appliances
   b. Hours used for a month
   c. What you pay per kw hour

   This formula will help you be aware of how much energy you buy each month.

   Wattage x hours x rate = operating rate

Energy Activity No. 70

Title: Food Cycle Energy Steps

Concept: Energy can be saved by eliminating steps in food chain.

Objective: To enable students to isolate energy consuming steps in the food system and to speculate as to the different ways in which energy could be saved.

Subject Area: Home Economics

Level: 7-12

Time Involved: 30 minutes

Materials needed: Colored paper, pens, tacks, bulletin boards

Procedure:

1. Make a visual representation of the twelve steps below. (Suggest: color paper tacked on bulletin board so steps can be moved around.)

   a. Someone else grows a vegetable.
   b. Transports it to a processing plant.
   c. It is sliced by machine.
   d. It is packaged.
   e. It is frozen.
   f. Refrigerated truck takes it to market.
   g. Market keeps it frozen.
   h. You drive to market to buy it.
   i. Take home and put in freezer.
   j. Thaw it and cook it.
   k. Throw away package.
   l. Eat it.

2. Remove any steps which could be eliminated to save energy.

3. Construct the food chain for an aluminum soft drink can and then make suggestions for steps which might be eliminated to save energy.

Possible answers to 2.

a. Someone else grows a vegetable.
Transports it to market.
Refrigerates it at the market.
You drive to market and buy it.
Take it home and cook it.
Eat it.

b. Grow a vegetable in your own garden.
Cook it.
Eat it.

c. Grow a vegetable in your own garden.
Eat it raw.

Energy Activity No. 71

Title: Energy Attitudes

Concept: Each form of energy can be used in many ways.

Objective: The student will be able to rank energy activities.

Subject Area: All Areas	**Level:** 7-12	**Time involved:** 1 class period

Materials needed:

Procedure:

1. Following you will see a list of energy activities. These activities require energy for their manufacture, use, and disposal. Check your responses in column "A" with one being the most <u>important</u> to twenty being the least important. Discussion follows.

2. Now that you have ranked these items according to their importance to you, rank the same items on the basis of energy efficiency in column "B." Discussion follows.

3. Now, following discussion, rank these activities in column "C" according to your own priority based on the discussion of columns "A" and "B."

Energy Activity No. 71
(continued)

	A Importance	B Efficiency	C Priority	
1.	_____	_____	_____	Watching TV
2.	_____	_____	_____	Using hot water for bathing
3.	_____	_____	_____	Using electric toothbrush
4.	_____	_____	_____	Using waffle iron
5.	_____	_____	_____	Reading a book
6.	_____	_____	_____	Eating a raw apple
7.	_____	_____	_____	Cooking a TV dinner
8.	_____	_____	_____	Riding car to store
9.	_____	_____	_____	Driving to a movie
10.	_____	_____	_____	Making homemade ice cream
11.	_____	_____	_____	Applying lipstick or cologne
12.	_____	_____	_____	Shaving with electric razor
13.	_____	_____	_____	Spraying aerosol deodorant
14.	_____	_____	_____	Using electric hairdryer
15.	_____	_____	_____	Riding a bicycle
16.	_____	_____	_____	Taking a walk in the sun
17.	_____	_____	_____	Eating a candy bar
18.	_____	_____	_____	Attending a night football game
19.	_____	_____	_____	Eating a hot school lunch
20.	_____	_____	_____	Riding a school bus

Energy Activity No. 72

Title: Solar Collectors

Concept: Presently, most of our energy requirements are met thru using fossil fuels. However, there are other alternative sources of energy such as solar, wind, fission, fusion, hydrogen, hydro and geothermal which must be considered and developed.

Objective: To demonstrate the construction and use of a solar collector.

Subject Area: Science	**Level:** 10-12	**Time involved:** Variable

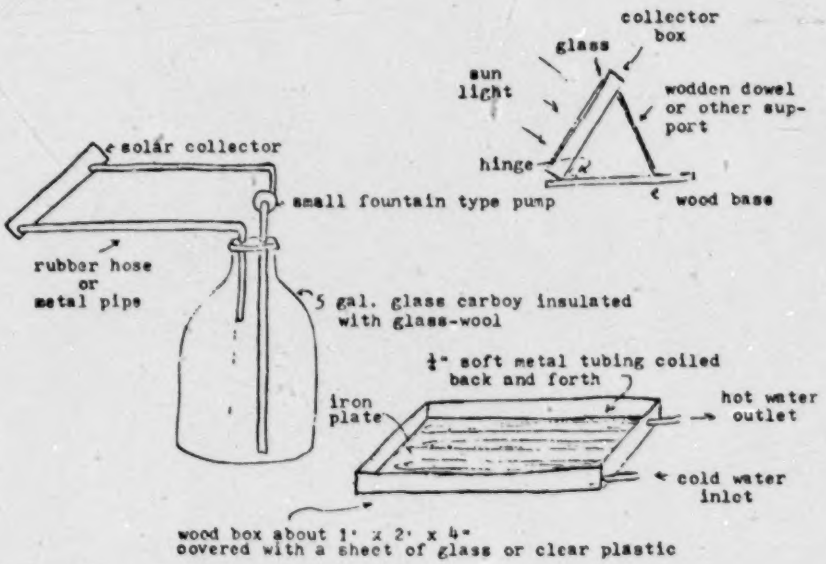
Materials needed: Listed in procedure

Procedure:

Each of the following are outlines for suggested student projects in solar power. The outlines are intended to serve as starting points only and are not to be taken as a set of step-by-step instructions on how to build or design solar collectors.

Activity 1

Construction of simple solar collector:


collector box
glass
sun light
wodden dowel or other support
hinge
wood base
solar collector
small fountain type pump
rubber hose or metal pipe
5 gal. glass carboy insulated with glass-wool
¼" soft metal tubing coiled back and forth
iron plate
hot water outlet
cold water inlet
wood box about 1' x 2' x 4" covered with a sheet of glass or clear plastic

Construct wooden box, place iron plate with tubing secured on surface inside, paint flat black, cover with glass and place on roof.

Water lines running from roof to classroom should be insulated. Soft rubber sheathing used by air-conditioner contractors should be ideal.

Pump should have a small flow rate but develop enough pressure to push water up to roof. Depending on climate, anti-freeze may be added to prevent bursting pipes in winter.

Recirculate water during daylight only and take temperature readings several times per day over a period of a few weeks. Determine maximum temperature reading.

Activity 2

Prepare three essentially identical collector systems and vary the tilt referenced to horizontal. Set one collector so measure of angle is equal to latitude above equator. Vary the other collectors and determine the most efficient placement for your geographic location.

Activity 3

Use three identical collector systems set at optimum angle. Connect the three heat reservoirs in series with each other. Determine if placing the collectors in series or parallel will be more efficient. Propose an explanation for your results.

Activity 4

To get more realistic results, place a load on your system by drawing off a small quantity of the hot water and make it up with cold. A flow rate of about .1 total volume per hour would be a reasonable load. Determine power rating of system by measuring flow rate and average temperature change. If possible collect data over several months.

Activity 5

To make the system more efficient, design and install a control device to detect the temperature increase in the collector and interconnect with the pump. The system should circulate water when there is a heat gain in the coil and shut off when not.

Activity 6

If small experimental system begins to operate effectively, design a larger model using a discarded hot water heater as the tank. Try to use the hot water produced for as many useful purposes as possible. Some examples are: hot water for washing glassware, design a heat exchange and use the heat to warm aquariums, use the heat to warm animal rooms, plant rooms or greenhouses.

Energy Activity No. 73

Title: "Drive 55 and Survive"

Concept: Energy, its production, use, and conservation are essential in the maintenance of our society as we know it.

Objective: To examine attitudes toward lowered speed limits.

Subject Area: Social Studies, Language Arts

Level: 10-12

Time involved: Variable

Materials needed:

Procedure:

Speed requires energy. Most automobiles operate much more efficiently at 50 mph than at 70 mph. As an energy conservation measure, the U. S. government in 1973 lowered the speed limit on the interstate highway system from 65 to 55 mph. Daily experience of persons driving along the interstate system verifies that the 55 mph limit is violated by enormous numbers of drivers. An increasing use of citizen band radios by truck drivers and some motorists appears to be a deliberate attempt to foil the police in their efforts to enforce the lowered speed limits.

Ask each member of the class to interview two or three licensed drivers with a series of questions such as: How seriously do you regard the 55 mph limit? How seriously, in your judgment, do other drivers appear to regard it? Do you think it was a good idea to try to slow down traffic to save energy? Do you think it is okay to use the CB radios to "beat the police"?

Pool and discuss findings in a class setting. Share conclusions in a class developed "letter to the editor."

Energy Activity No. 74

Title: Consumptive vs. Non-Consumptive Recreation

Concept: Energy, its production, use, and conservation are essential in the maintenance of our society as we know it.

Objective: To consider the desirability of reducing energy used for recreational purposes.

Subject Area: Social Studies, Language Arts, PE

Level: 10-12

Time involved: Variable

Materials needed:

Procedure:

Review with the class the general idea that recreational activities consume tremendous amounts of energy in the United States. Involve the class in listing some of the biggest users such as night baseball games, the Indianapolis 500 automobile race, air-conditioned playing areas such as the Superdome, Monday night football on TV, and others.

Organize the class to simulate a Senate subcommittee charged with investigating the desirability of outlawing or drastically reducing high energy use recreational activities such as those cited above.

Urge students to prepare and read short written statements in support of or in opposition to the idea under investigation. A "committee" of three to five students should be given opportunity to question the witnesses after their presentations.

After hearing all testimony the committee should prepare the recommendations it will submit to the Senate (entire class) on this issue. The report should include the major considerations that shaped the judgment of the committee.

Energy Activity No. 74
(continued)

The committee report should be made available in written or oral form to the entire class which after study and review votes to accept or reject the subcommittee recommendations.

Energy Activity No. 75

Title: "Whose Rights are Right?"

Concept: The production and distribution of energy have environmental and economic consequences.

Objective: To confront students with the problem of making energy-related value decisions.

Subject Area: Science, Social Studies	**Level:** 10-12	**Time involved:** Variable

Materials needed:

Procedure:

Students are arranged into groups of four. Each student is given a copy of the case study and several related questions. As a group they are to discuss the problems involved and try to come to a group decision.

CASE STUDY

Area: Along the Ohio River, in an area called the Big Bend

Location: A 350 acre farm

History: The people living in the area are direct descendents from the original owner, a Southern plantation master. The area was once a thriving plantation located along the banks of the river. Today, a single woman resides on the farm in question. She is the granddaughter of the original owner. The current owner cares little for the farming way of life, but has a religious reverence for the land of her forefathers. Recently, she learned that less than 400 feet down on her land there is a four-foot seam of coal. In addition, natural gas has been found on her farm. She has

agreed to allow the gas to be pumped out but no gas has been removed to date. Not only that, but various individuals in the gas company have reputedly asked for secrecy concerning her wells.

Beyond this, a large electric company is considering buying her farm as a site for a nuclear power plant. In attempting to purchase the farm, the electric company reputedly claimed no knowledge of the coal seam. Currently the owner does not want to sell. If she refuses, the state will condemn her land, buy it and sell it to the power company.

Questions:

Does an individual have the right to refuse to sell his/her land? Does a power company have a responsibility to be completely frank with potential land purchases? Should land be used for "national need" as opposed to "personal need"? If you were a power company president, would you take the ancestral home from a 75-year-old widow? Should a power company own land which it does not intend to build a plant on?

Energy Activity No. 76

Title: An Energy Menu

Concept: Wise food choices can save energy.

Objective: To indicate the equivalent energy costs of different foods and how wise food choices can save energy.

Subject Area:	**Level:**	**Time Involved:**
Home Economics, Consumer Education, Science	10-12	1 or 2 45 minute periods

Materials needed:

Procedure:

Review the items offered in the menu on the following page and select your "first preferences" based strictly on likes and dislikes. Place checks beside those items in Column 1. Next, make selections from the menu on the basis of least energy consumption. Remember, the energy cost of a food includes: fertilizers and insecticides, equipment; transportation; processing, packaging, and preparation. Place a check by each "low energy" item selected in Column 2. Then refer to the Energy Price list for each item's energy cost. Indicate the "price" of each item you chose and determine your total bill. To discover how you might have saved energy, find the differences between the individual items in the two columns and enter those figures in Column 3. The differences will be losses or gains in costs. Add the total "pluses and minuses" in this column to find total energy savings. If you were to select items for Column 1 (preferences) again, would your choices be any different?

ENERGY MENU

APPETIZERS (Choose one from each pair)	1 First Preference	2 Least Energy	3 Differences (+ or -)
Frozen Juice			
Fresh Juice			
Crackers (unwrapped, available to the restaurant in bulk)			
Crackers (wrapped individually, packed in small cartons)			
Butter			
Margarine			
MAIN DISH (Please make a first and second choice as we do not always carry each entree)			
Luncheon Meat			
Chicken			
Turkey			
Rice with Vegetables			
Beef (grass-fed)			
Beef (grain-fed)			
VEGETABLES (Sorry, today we have only carrots, but you may choose your preferred type)			
Fresh Carrots			
Dehydrated Carrots			
Frozen Carrots			
Canned Carrots			
DRINKS (Please choose a first and second choice as we sometimes run short of one kind of drink at lunch)			
Soft drink (in aluminum can)			
Soft drink (in returnable glass bottle)			
Milk			
Beer (in aluminum can)			
Beer (in returnable glass bottle)			

DESSERT
(Choose one)

Apples (homegrown in our restaurant's own garden)	_____	_____	_____
Apples (store-bought)	_____	_____	_____
Walnuts (shelled)	_____	_____	_____
Walnuts (unshelled)	_____	_____	_____
Ice Cream	_____	_____	_____
TOTAL BILL	_____	_____	_____

ENERGY PRICES

(Prices are proportional to actual energy expenditure)

APPETIZERS:

Fresh juice: 12¢
Frozen juice: 46¢
(Freezing and processing use a great deal of energy, both initially and for storage)
Cracker A: 10¢
Cracker B: 15¢
(Food excessively packaged or only available in small packages is more energy-intensive than unwrapped foods or foods available in bulk)
Butter: 15¢
Margarine: 5¢

MAIN DISH:

Luncheon Meat: $1.60
Chicken: 96¢
Turkey: $1.06
Rice with Vegetables: 45¢
Beef (grass-fed): $1.48
Beef (grain-fed): $2.08

(Animals are inefficient converters of protein. A pound of meat requires about four times the energy to produce and market as a pound of vegetable protein. Some animals are more efficient converters of protein than others.)

VEGETABLES:

Fresh Carrots: 12¢
Dehydrated Carrots: 92¢
Frozen Carrots: 31¢
Canned Carrots: 23¢
(Processed vegetables require more energy than fresh vegetables; freezing and dehydration especially require large amounts of energy)

DRINKS:

Soft Drink (aluminum can): 45¢
Soft Drink (returnable bottle): 31¢
Milk: 34¢
Beer (aluminum can): 50¢
Beer (returnable bottle): 25¢

DESSERT:

Homegrown apple: 3¢
Store-bought apple: 19¢
(Homegrown apple by commercial methods saves commerce and transport; organic methods would save more)
Walnuts, shelled: $1.04
Walnuts, unshelled: 39¢
Ice Cream: 60¢
(Large quantities of milk are used; freezing is necessary)

Energy Activity No. 77

Title: Community Awareness Index

Concept: Every decision made involving energy affects standards of living.

Objective: Build a level of awareness in the community consistent with our growing understanding of energy.

Subject Area:	**Level:**	**Time involved:**
Social Science, Science, Consumer Education	10-12	6-10 class periods

Materials needed: Tape recorders, survey forms

Procedure:

These projects should be carried out by individuals or small groups of students. Each student or group of students identify two or three of these activities that he or she would like to complete. Take into consideration activities may last more than a week.

1. Survey local auto dealers on these topics:

   a. Should the government place levels on horsepower?
   b. On gas mileage?
   c. On sales trends of subcompact cars?
   d. What techniques could be used to encourage energy awareness?

2. Interview four or five representatives of local commercial establishments to find out what each is doing to conserve energy in heating, cooling, lighting, and using equipment as well as transportation.

Energy Activity No. 77
(continued)

3. Survey appliance dealers on these topics:

   a. What appliances seem to be selling well?
   b. Which ones are not?
   c. What percentage of the customers inquire about the energy efficiency ratio when they are purchasing a major appliance?

4. Get an appointment with a representative of your local utility or utilities. Interview him/her on the following:

   a. Does the utility activity assist customers to use less energy?
   b. What part of the rate increases over the last five years was due to fuel cost changes?
   c. How does the size and type of gas and electric utilities vary with customers?

5. Using advertising fliers from Sunday newspapers, ask students to list all items using energy which families could buy as luxuries but which are not necessary in homes. Discuss these decisions related to encouragement to consume.

Energy Activity No. 78

Title: Heat Conversion and Transfer

Concept: All conversion processes use energy or lose heat energy.

Objective: The student will be able to understand that heat can be converted and transferred from one place to another by molecular motion.

Subject Area: Science, Math

Level: 10-12

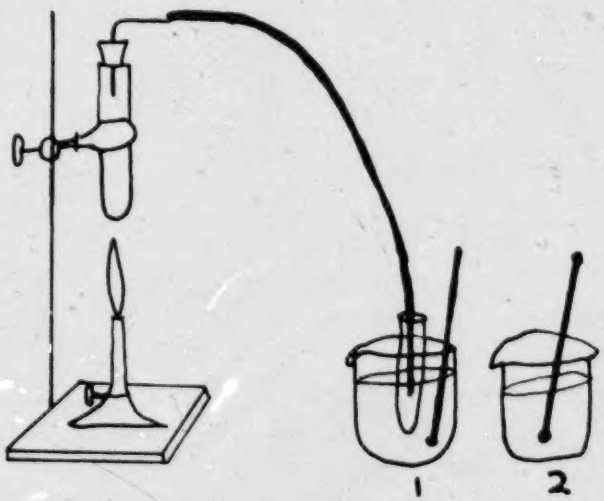
Time involved: 1-2 classroom periods

Materials needed: alcohol burner or heat source, 2 test tubes, one hole stopper, right-angle glass bend, rubber tubing, 2 beakers, 2 thermometers, ring stand with clamps

Procedure:

1. Set up the apparatus as shown so that you are heating 1/2 of a test tube of water and conducting the steam to a second test tube which should be immersed in a beaker of cold water.
2. A thermometer should be placed in the beaker of cold water and an initial reading should be made.
3. A second beaker of cold water with a thermometer in it should be placed near the first.
4. Heat the test tube containing the water until half is boiled away.
5. While heating the water, periodic temperature readings of both beakers of water should be made and recorded on a graph.
6. Have the students explain the results of the data collected by answering the following questions:

a. In what state of matter did the water travel from the first to second test tube?
b. What happened to the temperature of the water in both beakers?
c. What caused the temperature results?
d. Which state of matter of water contained more energy?
e. Can energy be transferred from one place to another by changing the characteristics of a substance with heat?
f. Think of an example of this process found in nature.



Energy Activity No. 79

Title: Processing Food by Canning

Concept: You can save energy and money by processing foods yourself.

Objective: The students will process food by canning apples and be able to conclude that the process saves energy and money.

Subject Area:	**Level:**	**Time involved:**
Home economics, science, agriculture	10-12	2 - 45 minute sessions

Materials needed: Apples, knives, heat source, pan, bowl, salt, water, collander, canning jar, canning lid

Procedure:

1. Wash apples.
2. Cut into pieces and place in salt water (keeps apples from turning brown).
3. Cook until soft (may need to add water), put through collander.
4. Sterilize jars and tops for minimum of 20 minutes.
5. While everything is hot, put applesauce in jar and seal.
6. Compare the amount of energy you used in preparing the apples for canning and the amount of energy needed to prepare canned applesauce from grocery.
7. Compare your cost with the cost of an equal amount of applesauce from the grocery (consider cost of transportation, etc.).

Energy Activity No. 80

Title: "Coal vs. Aquatic Ecosystem"

Concept: Production of energy has environmental and economical consequences.

Objective: To find out the effects of gases emitted from the burning of coal in a closed ecosystem.

Subject Area: Science, Social Studies

Level: 10-12

Time involved: Variable

Materials needed: 2 - 1 gallon jars and lids, plants, sand, 2 glass tubing sections, 1 hole stopper, 1 stopper, 1 ring stand and clamp, 1 bunsen burner, fish, 1 22 x 180 mm test tube

Procedure:

Fill both jars with aquarium H_2O to same level. Add equal amounts of sand, add several strands of elodea and allow them to either float or root them. Let aquaria set for one week. Introduce male and female guppies and feed for several days. Seal jars (one lid should have hole large enough for glass tube). Place one gram of finely ground coal in 22 x 180 mm test tube. Place longer glass tubing through the hole in the lid of one jar. Connect glass tubing with rubber tubing. Burn coal with bunsen burner (as temperature drops the water may be pulled into tube). Repeat the process daily or weekly for several weeks. Have students record changes which occur. Keep jars out of direct sunlight and under same environmental conditions.

a. What effect does the burning coal have on these closed systems?
b. Compare and contrast the effects of burning coal on an aquatic ecosystem and a terrestrial ecosystem.
c. Discuss the social consequences of burning of coal vs. the use of other fuels.

Energy Activity No. 81

Title: "Mapping Energy Resources in Kentucky"

Concept: There are several energy resources in Kentucky.

Objective: Given information on energy resources of Kentucky, the student will plot this information on a map of the state and draw conclusions about its uses.

Subject Area: Geography, Science

Level: 7-12

Time involved: 1-2 45 minute periods

Materials needed: Map of Kentucky, colored pencils

Procedure:

1. Using resources available and a map of Kentucky, locate your city. Also identify these areas: Frankfort, Lexington, Louisville, Paducah, Owensboro, Madisonville, Central City, Hazard, Ashland.
2. Design your own key (a symbol for each type of source) and plot the energy resources of the state - natural and manmade.
3. What seems to be the most widespread resource?
4. What seems to be the most abundant resource?
5. Do you think Kentucky could be energy independent? Why?
6. Does it appear that Kentucky needs to import any energy resources?
7. Do you suppose Kentucky exports any energy resources?

Energy Activity No. 82

Title: "The Winter of '77 - How We Coped With the Energy Shortage"

Concept: The winter of 1977 presented society with complex energy problems and made unusual social changes in culture.

Objective: To analyze energy availability to demand and to determine the interrelationships between citizens, utility companies and governmental agencies.

Subject Area: Social Studies	**Level:** 9-12	**Time involved:** 1 week

Materials needed: News articles, magazines

Procedure:

1. Through brainstorming, students will compile a list of the effects the winter of '77 had on their lives.
2. Students will question by interviewing homeowners and government officials to see how the winter affected them.
3. Student groups will analyze news articles from the winter of '77 to see which agencies responded to the crisis and how they responded.
4. Students will classify agencies which helped in the city to see what each organization did in response to the crisis.
5. Guests of various organizations will be invited to class for a panel discussion on the response to the energy crisis. (Chamber of Commerce, Kiwanas, various civic clubs)
6. Students will, through interviews, determine budget overloads in government, social agencies, schools, churches, public buildings.

Energy Activity No. 82
(continued)

7. Students will compile a bulletin board display on energy use during the winter of '77.

Energy Activity No. 83

Title: "Don't Flip Your Bic (The Day the Power Failed)"

Concept: Energy sources are taken for granted.

Objective: The student will become aware of his dependence on energy.

Subject Area: Science, Social Studies

Level: 10-12

Time Involved: 1 period

Materials needed: Resource people in the community

Procedure:

1. Several days before this activity period, assign student groups to find the roles and responsibilities of the following community leaders: mayor, police chief, fire chief, city manager, utility directors, etc.
2. On day of activity, darken room, turn off all electrical energy sources and have students develop a model of a city without electrical power, for 48 to 72 hours.
3. Show film: When the Circuit Breaks or make your own and show what happens during a blackout.
4. Discuss problems of the power break during the classroom blackout using the following guide questions or suggestions.
   a. List all items that depend on electrical power that would be out of service.
   b. Discuss the relationship between energy conumption and energy needs.

Energy Activity No. 83
(continued)

c. Discuss possible short-term and long-term solutions to energy blackouts.

Energy Activity No. 84

Title: "Don't Eat The Chicken"

Concept: Energy transfers - trophic levels

Objective: The student will examine the progressive energy loss in a food pyramid.

Subject Area: Home Economics, Biology

Level: 10-12

Time Involved: 1 period

Materials needed: Biology text, film

Procedure:

This activity must follow class discussion on energy pyramids.

The student is stranded on an island. He or she has an unlimited supply of water and shelter. Also, on this island is a crate of live chickens (hens only) and a case of wheaties.

Assuming both of these sources will be used as food, which would be the most efficient use of food energy.

1. Eat the wheaties first and then the chickens (chickens lose weight while wheaties are eaten).
2. Eat chickens first and then the wheaties (least energy).
3. Feed the wheaties to the chickens and then eat the chickens (too many energy transfers).
4. Feed the wheaties to the chickens, eat half the chickens and allow

remaining half to lay eggs, allow the eggs to hatch and start cycle over again (too many energy transfers, no rooster).

5. Add your own choices.

6. Allow students to discuss or research before answering problems.

Energy Activity No. 85

Title: Energy Graffiti

Concept: Attitudes toward energy conservation vary with individuals.

Objective: Student express ideas and feelings through graffiti about energy.

Subject Area: Art

Level: Any

Time involved: 30 minutes

Materials needed: Large sheet of paper, crayons, magic markers,

Procedure:

Post a large sheet of paper. Let students write slogans, draw pictures, or dootle about energy. Post in the all or somewhere that others can observe or add to it.

Energy Activity No. 86

Title: "Double Exposure Energy"

Concept: Some appliances use varying amounts of energy yet serve the same purpose.

Objective: Students will become aware that different consumers of energy provide the same service.

Subject Area: Science

Level: Any

Time involved: 2 - 30 minute sessions

Materials needed: Polaroid camera with film

Procedure:

Students take double exposure pictures of things that consume much energy and those that don't but serve the same purpose. (Example: luxury automobile and economy car, bicycle and car, etc.)

Display the pictures.

BIBLIOGRAPHY

American Association for the Advancement of Science
Office of Science Education
1776 Massachusetts Avenue, NW
Washington, D. C. 20036

Energy and Society. Individual learning modules which take from two days to several weeks for completion are a feature of this guide. The activities are designed to be incorporated into regular courses. Grades 9-12.

American Gas Association
Educational Services
1515 Wilson Boulevard
Arlington, Virginia 22209

Experiments: Properties of Gas and Heat Energy. Seventeen experiments on properties of gas and fourteen experiments on heat energy. Prepared on spirit duplicating masters for easy reproduction by teachers for student use. For junior and senior high school students.

Gas Centered Projects for Science Fairs. Pamphlet for junior and senior high school students. Contains 32 projects and references for further study.

How Your Gas Meter Works. A teaching kit in simple, lay language, with illustrations and diagrams, explaining the workings of the gas meter. Designed for use at the junior high school teaching level in General Science and Social Studies classes. Included are: one booklet "How Your Gas Meter Works"; one wall chart, 17" x 22" in two colors; two spirit duplication masters for reproducing student handout sheets.

Natural Gas Serves Our Community. A cut-out kit for the elementary school level. Consists of 28 pictures on pasteboard in four colors depicting the story of gas from the gas fields to the community and its many uses there plus ribbon for pipelines and identifying banner. Included is a text with illustrations in four colors. It describes where gas is found, how it is located, and the flow of gas from source to home or industry. Two sets: one is written for 2-3 grade level, the other for 4-5 grade level.

Science Principles and Gas Appliances with Experiments. A booklet on science principles used in six gas appliances: range, home heater, water heater, clothes dryer, incinerator, and air conditioner. Includes twelve classroom experiments. Materials for overhead projection and simple report sheet included. Grades 7-9.

What is Gas? A book of 12 classroom demonstration/experiments. How does a child learn about matter that exists in a gaseous state if it is colorless, odorless, tasteless, has little weight, and moves silently? The demonstration/experiments suggest way that some concepts about the world of gases may be developed. Grades 4-6.

American Nuclear Society
244 East Ogden Avenue
Hinsdale, Illinois 60521

Nuclear Power and the Environment - Questions and Answers, 1974. Contains understandable and useful information and answers to commonly asked questions on nuclear power and the environment.

Bradbury Press
Two Overhill Road
Scarsdale, New York 10583

Gift From the Sun, 1969. Good historical survey of solar energy for students in grades 5-8. $5.95 hardcover.

Center for Environmental Learning
705 Avocado Avenue
Cocoa, Florida 32922

Teacher's Environmental Resource Unit: Energy and Power, 1975. Contains current information concerned with the U. S. energy crisis and its environmental impact. It is intended to give the classroom teacher a basic understanding of the environmental problems that the need for energy and power has created. Also includes an overview of energy needs, the pollution factors to be dealt with, possible solutions, and estimates of the cost factors involved. $1.10.

Children's Press
1224 W. Van Buren Street
Chicago, Illinois 60607

The True Book of Energy, 1963. This illustrated book introduces the many types of energy and its importance. Primary grades. $3.75.

Citizen's Advisory Committee on Environmental Quality
1700 Pennsylvania Avenue, NW
Washington, D. C. 20006

Citizen Action Guide to Energy Conservation, 1973. Booklet directed to citizen leaders, public officials, and others

who are in a position to promote understanding of the need for energy conservation and to encourage its practice on a broad scale by the American people. $1.75.

Committee for Environmental Information
438 N. Skinner Boulevard
St. Louis, Missouri 63130

Energy, The Enduring Crisis, 1974. Self-contained teaching units on "The Energy Problem," "Oil Case Study," "Energy Alternatives," and "Conservation." Grades 9-12.

Crowell, Thomas Y., Co.
666 Fifth Avenue
New York, New York 10019

The Sun, Our Nearest Star, 1961. Tells why the sun is necessary to our lives. Describes its size, shape, and characteristics. Primary grades. $3.75.

Dover Publications
180 Varick Street
New York, New York 10014

The Concept of Energy Simply Explained, 1964. A Dover reprint discussing heat energy, heat engines, and the laws of thermodynamics. In non-technical language, such topics as the heat theory, energy conservation, and entropy are presented. Recommended for high school students and teachers. $1.50.

Dutchess County Board of Cooperative Education Services
R.D. 1
Salt Point Turnpike
Poughkeepsie, New York 12601

Energy, Key to the Future, 1974. This book of teaching techniques for the understanding and conservation of energy is geared for grades K-12. They are not complete lesson plans but, rather, ideas that act as starting points for further development by the teacher.

Edison Electric Institute
Education Services
90 Park Avenue
New York, New York 10016

The Energy Challenge: What Can We Do?, 1974. Recommended for grades 3-12.

Energy Conservation: Experiments You Can Do, 1974. Recommended for grades 5-10.

The Energy--Environment Game, 1973. This game deals with energy demand and the effect it has on the environment. Students become the decision-makers in this simulation of reality. Recommended for science, social studies and English classes in grades 7-12. Materials for 32 players are included along with teacher's guidebook - $25.00; education institutions, $20.00.

Education Turnkey Systems, Inc.
1660 L Street, NW
Suite 1213
Washington, D. C. 20036

Energy Education Series. A series of eight monthly packets containing overhead projections, story records, activities, and experimental kits. Elementary level. $79.50

Electric Energy Association
90 Park Avenue
New York, New York 10016

Cost and Energy Savings Opportunities with Heating, Air Conditioning, and Lighting Systems in Schools, 1973. Electric space heating and air conditioning and lighting concepts are reviewed with new construction and modernization discussed. Single copies free; multiple copies .65 each.

Electrical Industries Association
6055 East Washington Boulevard
Los Angeles, California 90040

The Energy Saving Guidebook. Recommended for grades 3-12.

Energy Challenge, The
Box 14306
Dayton, Ohio 45414

The Energy Challenge. An activity program of ditto masters about our energy past, present and future. Grades 5-8. Free.

Energy and Man's Environment
0224 SW Hamilton, Suite 301
Portland, Oregon 97201

Energy and Man's Environment Activity Guide: An Interdisciplinary Teacher's Guide to Energy and Environmental Activities, 2nd edition, 1976. This is a set of eight booklets containing

energy and environmentally related instructional ideas and activities. The first booklet, Energy Activity Guide, contains general information about the guide, suggestions for its use, and an outline of the goals and concepts of the other guide booklets. The six major sections of the guide are: (1) Sources of Energy in which activities focus primarily on the availability of resources, forms of energy, natural laws, and socio-economic considerations; (2) Uses of Energy with activities focusing on energy awareness, energy conservation, and energy-use planning for greater personal involvement in decision-making; (3) in the section on Conversion of Energy, the activities focus on understanding conversion processes, efficiencies, socio-economic costs, and personal decision-making; (4) Impact of Energy focuses on the impact that energy extraction and use has on the environment, which energy sources have more or less impact than others, and personal decision-making; (5) The Limits of Energy section has activities related to understanding the nature and natural limits to growth, consumption practices, and technical and social implications of depleting the natural resources of the world; (6) Future Sources of Energy has activities related to advanced technologies and the implication of their development. The eighth booklet in the set is an extensive glossary of energy and environmental terms. $25 per set.

Environmental Education and Science Resource Center
Marsha Bagby School
95th and Mohawk
Shawnee Mission, Kansas 66206

Changes Ahead for Gas-Guzzling America. This module is concerned with the fuel crisis as it pertains to the most immediate facet of a young student's life -- his car and his job. What is the nature of this crisis and what possible changes may result are the two questions this module attempts to answer. Recommended for driver-aged students, especially in grade 12. $1.50 per module.

ERIC Center for Science, Mathematics,
and Environmental Education
College of Education
The Ohio State University
1200 Chambers Road, Third Floor
Columbus, Ohio 43212

Energy Activities for the Classroom, 1976. A multidisciplinary guide to energy activities for grades K-12. Ideas and factual content are drawn from materials in the ERIC Center for Science, Mathematics, and Environmental Education. An excellent planning document.

Evans, M., and Co., Inc.
J. B. Lippincott Company
East Washington Square
Philadelphia, Pennsylvania 19105

Energy in the World of the Future, 1973. Covers geothermal, nuclear, solar, and wind. For high school students. $5.95 hardcover.

Federal Energy Administration
Publication Distribution Office
12th Street and Pennsylvania Avenue, NW
Washington, D. C. 20461

Energy Activities with Energy Ant. Written for third grade students, this activity guide is in coloring book form. It contains games, puzzles, and much more. A teacher's guide, "A Note From Energy Ant," lists additional materials and resources. $1.40.

Tips for Energy Savers recommends practical and simple ways to conserving energy in the kitchen, workshop, yard, and garden during both hot and cold weather and while driving and vacationing. Gives hints about buying energy-efficient merchandise.

Ford Foundation, The
Energy Policy Project
P. O. Box 23212
Washington, D. C. 20024

Exploring Energy Choices, 1974. This is a preliminary report of the Energy Policy Project of the Ford Foundation. It seeks to provide a framework for thinking about energy policy.

A Time to Choose: America's Energy Future, 1974. This is the final report by the Energy Policy Project of the Ford Foundation. Discusses energy and the American consumer, the economy, the environment, and the world. The book also gives the conclusions and recommendations of the Energy Policy Project staff and Advisory Board. $12.95 hardcover, $4.95 softcover.

Grist Mill, The
90 Depot Road
Eliot, Maine 03903

The Energy Miser's Manual, 1975. This booklet contains many ideas on how to go about cutting down on energy use. $2.25 paperback.

Harvey House
55 Buckhout Street
Irvington-on-Hudson, New York 10533

Thank you Mr. Sun!, 1957. This picture book with text explains the many things the sun gives us -- water, food, warmth, etc. Primary grades. $3.36.

The Story of Radioactivity, 1971. This book is concerned with radioactivity and its implication to man. Grades 7-9. $4.50.

Interstate Energy Conservation Leadership Project
Colorado Department of Education
201 East Colfax Avenue
Denver, Colorado 80203

Energy Conservation Materials Package. A set of four booklets for educators concerned with energy conservation. Very practical information. The booklets included are (1) "Energy Conservation in School Facilities"; (2) "District Level Plan for Conservation"; (3) "Energy Conservation in the School Curriculum"; and (4) "Energy Conservation in School Transportation Systems."

A Teacher's Handbook on Energy, 1974. This K-12 guide contains activities to be used both in and out of the classroom so that students will gain a picture of the total energy problem. Background information and visual aids are included.

Iowa State University
Cooperative Extension Service
Ames, Iowa 50010

Energy Awareness. Iowa 4-H program materials on energy for 4-H leaders and junior, intermediate, and senior members.

Kingsport City Schools
1701 East Center Street
Kingsport, Tennessee 37664

Energy Activities and Resources for the Secondary Student. Composed of several interdisciplinary activities, the primary purpose of these resources is to create within the student an awareness of our energy related problems through involvement. Recommended for students in grades 7-12.

Lee County Environmental Education Program
2266 Second Street
Fort Myers, Florida 33901

The Energy Crisis. Five-lesson units for 4th and 5th grades. The fourth grade unit contains material on energy conservation. There

are two fifth grade units on the energy crisis -- one designed for language arts, the other for social studies.

Massachusetts Audubon Society
Hatheway Environmental Education Institute
Lincoln, Massachusetts 01773

The Energy Crisis - Aids to Study, 1974. Compiled for U. S. Office of Education. Bibliography of books, magazine articles, and curriculum aids which will be useful in beginning a study of the energy crisis.

McDonald's Corporation
Public Relations Manager
One McDonald's Plaza
Oak Brook, Illinois 60521

McDonald's Ecology Action Pack, 1974. The Ecology Action Pack has been designed to make the teaching of environmental awareness a little easier for the instructor. Included are spirit duplicating masters for a student-made hanging display, a food chain wheel with two sets of questions to be used with it, the water cycle and activities to encourage water conservation, a history of trash, recycling, and energy conservation measures. Also includes a transparency on the food chain. Basically for grades 3-6, but parts may be useful in junior high classes.

Michigan Association of School Administration
Region Nine Superintendent
421 West Kalamazoo Street
Lansing, Michigan 48933

Energy Conservation Guidelines for Action, 1974. Includes curriculum guidelines, teacher background material, sample activities used in Michigan schools and a bibliography. K-12. .75 each; .70 for 12 or more.

Morgan and Morgan
145 Palisade Street
Dobbs Ferry, New York 10522

Harnessing the Sun to Heat Your House, 1975. A basic book on solar-heating. Contains detailed temperature statistics and formulas for calculating efficiency. $2.95 paperback.

Morrow, William and Co., Inc.
788 Bloomfield Avenue
Clifton, New Jersey 07012

The Conquest of Energy, 1968. In this book, the author examines uses and sources of energy, energy costs, and conversion from one form to another. Alternate fuel resources such as nuclear power, solar energy, and geothermal energy are also discussed along with biochemical processes. Grades 8-12. $6.95.

The Sun, 1953. Discusses the sun - its characteristics, the ways people depend on it, eclipses, the sun as a source of energy, and the sun as a star. Grades 4-6.

National Education Association
1201 Sixteenth Street, NW
Washington, D. C. 20036

Energy Choices for Now: Saving, Using, Renewing. An Introduction to Energy in the Environment, 1974. The contents of this book are an introduction to the topic of energy in the environment. The material is meant to be used in any classroom where the environment is being studied and is designed to provide a variety of viewpoints, thus enabling the student to analyze, evaluate, and decide upon the energy alternatives open, both now and in the future. There is also an accompanying teacher guide to this book.

National Recreation and Park Association
Park Project on Energy Interpretation
1601 North Kent Street
Arlington, Virginia 22209

Energy Activity Guide, 1975. Contains information on all aspects of energy. Also includes games, think problems, and an energy table. Free.

National Science Teachers Association
1742 Connecticut Avenue, NW
Washington, D. C. 20009

Educator's Guide to Free Science Material, 1973. Two mini-units which were designed by teachers are included: "People and Power" and "Energy Crisis - A Chemical Problem." These mini-units use free materials from this guide. Grades 9-12.

Energy and Environment Packet. Various information booklets and a teacher's guide. Grades 2-6. $2.00.

The Energy-Environment Source Book, 1975. The book consists of two volumes, five technical appendices, and a glossary. It is written in an informal, easy-to-read style and is recommended for teachers of all disciplines. Volume 1, "Energy - Its Extraction, Conversion, and Use," deals with the basic energy facts. $4.00.

Energy-Environment Mini-Unit Guide, 1975. Consists of seven sample activities ranging in level from primary to high school. The activities are complete and ready to use and contain directions for the teachers, materials for students' use, and suggested ways to evaluate student achievement. $3.00.

Energy-Environment Materials Guide, 1975. This resource guide contains a sampling of current energy literature. There is a section with readings for teachers and sections with readings for students in grades 8-12, 5-9, K-6. Four appendices list films and audio-visual materials, curriculum materials, information sources, and governmental documents. $2.00.

The above three books can also be purchased as a set for $9.00.

National Wildlife Federation
Education Servicing Section
1312 Sixteenth Street, NW
Washington, D. C. 20036

"Special Report on Energy." This eight page discussion covers the energy shortage, how it developed, and how to solve it. It is well-illustrated, compact, and easy to read and understand. Fossil fuels, solar power, coal gasification, breeder reactors, and the rest of the energy vocabulary are explained in simple terms. Single copy free; additional copies are .15 each.

Energy: Selected Resource Materials for Developing Energy Education/Conservation Programs, 1975. This bibliography contains materials which relate to energy education/conservation such as curriculum guides and enrichment materials. Single copies free; additional copies .10 each.

New Jersey State Department of Education
180 West State Street
Trenton, New Jersey 08608

Energy Crisis: A Teacher's Resources Guide, 1975. Objectives, background content material, activities, references, and examples of measuring devices for every classroom use.

North Carolina Board of Education
Education Building
Raleigh, North Carolina 27603

Energy Conservation in North Carolina Public Schools and Institutions of the Community College System, 1974. The purpose of this booklet is to supply schools and institutions with ideas that might be used in long-range energy conservation planning concerning the educational plant.

North Carolina Department of Public Instruction
Division of Science Education
Raleigh, North Carolina 27611

Environmental Education - Strategies for Wise Use of Energy, 1974. An interdisciplinary guide for teachers in the elementary and secondary schools; certain portions could be used with adult groups.

Oregon Department of Education
942 Lancaster Drive, NE
Salem, Oregon 97310

Energy Crisis, Teaching Resources, 1974. This guide was written to provide school teachers and administrators with teaching ideas and information about the immediate energy crisis.

Parents' Magazine Enterprises, Inc.
52 Vanderbilt Avenue
New York, New York 10017

Fuel for Today and Tomorrow, 1974. A good book for students in grades 1-4. Tips on how everyone, even a child, can conserve energy. $3.97 hardcover.

Pennsylvania Department of Education
Box 911
Harrisburg, Pennsylvania 17126

The Environmental Impact of Electrical Power Generation: Nuclear and Fossil, 1973. This high school course material is an attempt to provide an unbiased, straightforward, and objective view of the advantages and disadvantages of nuclear generation of electrical power. An effort has been made to describe the cost-benefit ratio of the various methods of generation of electrical power. A teacher's guide with the same title is also available.

Nuclear Science: A High School Course, 1971. Provides a basic but comprehensive understanding of the atom in the light of modern knowledge. Special attention is paid to the use of nuclear energy as a contributing factor to modern civilization.

Supplementary Materials for Nuclear Science, 1971. This book is a supplementary to the text, Nuclear Science: A High School Course, also published by the Pennsylvania Department of Education. It furnishes the student with background information necessary for adequately comprehending topics covered in the nuclear science source.

Teacher's Guide for the Environmental Impact of Electrical Power Generation: Nuclear and Fossil, 1973. Teacher's accompaniment to The Environmental Impact of Electrical Power Generation: Nuclear and Fossil, also by the Pennsylvania Department of Education.

Portola Institute
558 Santa Cruz Avenue
Menlo Park, California 94536

Energy Primer, 1974. A not-too-technical introduction to the energy conservation. Plenty of information on manufacturers and equipment. $4.50 paperback.

Project ECOLogy
Title III, ESEA
Highline Public Schools
Department of Instruction
P. O. Box 66100
Seattle, Washington 98166

Energy Futures. Guide contains eleven complete energy focused lesson plans designed for junior high school science. Topics covered are (1) energy development; (2) personal energy use; (3) school and community energy use; (4) U. S. energy use; (5) renewable energy sources; (6) non-renewable energy sources; (7) conversion; (8) electric generation; (9) electric need and growth; (10) conservation; and (11) future energy sources.

Project S.E.E.
Wyandotte Public Schools
891 Goddard Road
Wyandotte, Michigan 48192

GREEP on Energy. Mini-units which were designed by students to be taught by teachers to other students. Grade 12.

Project U.S.E. (Urban/Suburban Environmental Education)
310 102nd Avenue, NW
Bellevue, Washington 98004

Curriculum Outline - Energy and Man's Environment, Grade Six, 1973. This draft contains developmental materials for the teaching of energy and man's environment. The content was developed as a result of the "Energy and Man's Environment" Institute, a five week summer institute for teachers of the Pacific Northwest. Changes and revisions are constantly taking place. The objectives of the program are broadly stated thus leaving it up to the individual teacher to decide the specific areas of study.

Putnam's, G. P., Sons
200 Madison Avenue
New York, New York

The Whole Earth Energy Crisis, 1973. This book covers the energy problem. Discussion runs the gauntlet from decreasing energy supplies to how present energy use is affecting the environment and energy policy developments. Grades 5-9. $4.89.

Science Education Resource Center
American Museum of Atomic Energy
P. O. Box 117
Oak Ridge, Tennessee 37830

The Plain Brown Rapper. This pamphlet contains short descriptions and addresses for various types of energy games, activities, and resources that are available to teachers. Free to teachers.

Sears, Roebuck and Company
Consumer Information Services
Department 703 - Public Relations
Sears Tower
Chicago, Illinois 60684

The Energy Crisis in the Classroom, 1974. Suggestions regarding energy conservation program for high school teachers.

Sierra Club, The
1050 Mills Tower
San Francisco, California 94104

Energy, 1971. Energy resources and consumption are discussed. Grades 10-12. $2.75 paperback.

State of Iowa
Department of Public Instruction
Grimes State Office Building
Des Moines, Iowa 50319

Energy Materials, 1973. A guide prepared for Iowa educators during Energy Awareness Week December, 1973. Provides information and materials dealing with primary energy sources, conservation, social issues and suggested classroom activities. Also includes a selected bibliography of books and periodicals, publisher addresses, list of additional resources, and glossary of energy terms.

Superintendent of Documents
Government Printing Office
Washington, D. C. 20402

Energy Conservation: Understanding and Activities for Young People, 1975. Discusses energy generally - what it is, where it comes from, energy and the future, energy conservation, and energy uses. Also includes a brief glossary, a short bibliography, and organizations to write for more information. .85 each.

National Energy Outlook, 1976. This report takes a look at the United States' ability to achieve energy independence and the problems faced in attaining that goal. $7.30.

Project Independence: A Summary, 1974. This report was prepared to present a comprehensive framework within which to evaluate individual issues of the energy problem. The impact of four very different strategies which high-light the choices we face are discussed. Summarized are domestic and world trends through 1973, leading up to the Arab oil embargo and its effect. $2.00.

In the Bank or Up the Chimney? - A Dollars and Cents Guide to Energy-Saving Home Improvements, 1975. A step-by-step guide to reducing energy consumption in the home through home-improvements such as insulation, storm-windows, etc. $1.70.

Tennessee Energy Office
Suite 250, Capitol Hill Building
Seventh and Union
Nashville, Tennessee 37219

Energy Handbook: Tennergy, 1975. This handbook has been prepared to serve as a basic reference manual for educators and students with a need for energy facts. Recommended for grades 7-12.

Time, Inc.
Time and Life Building
Rockefeller Center
New York, New York 10020

Energy, 1963. Brief descriptions of different forms and new sources of energy. Historical knowledge and illustrations. Grades 7-9. $5.70.

U. S. Environmental Protection Agency
Region I, New England Regional Office
Public Affairs Division
2203 John F. Kennedy Federal Building
Boston, Massachusetts 02203

Energy and the Environment: A Selected Bibliography for the Citizen, 1973. Free.

University of the State of New York, The
State Education Department
Albany, New York 12224

Living Within Our Means: Energy and Scarcity. There are two books with this title. One is written for grades K-6, the other for grades 7-12. Both contain activities for different subjects within the curriculum to allow an interdisciplinary approach to the energy problem.

University of Wisconsin, The
Sea Grant College Program
1800 University Avenue
Madison, Wisconsin 53706

The Household Energy Game, 1974. This booklet has been designed to give the reader some idea of how much energy he uses and how he can manage it. In the first part of the game, the reader formulates an "energy budget" showing how much energy is used. Then suggestions for modifying the budget in order to conserve energy are made. It would be appropriate for high school students and adult education groups. .10 each.

Utilities Educational Services
Division of Custom Comics, Inc.
10 West Nineteenth Street
New York, New York 10011

Our Spaceship Earth - Needs More Fuel!, 1974. Illustrated booklet on energy, grades 4-10, with teacher's guide.

Virginia Energy Office
823 East Main Street
Richmond, Virginia 23219

Energy in the Classroom, 1975. This is a three volume activity guide for teaching students to learn to live in a world where energy is becoming scarce and expensive and where conservation must be practiced if our standard of living is to be maintained.

Volume I, Activity Guide for K-3, contains ideas for introducing and discussing the concept of energy and how it applies to everyday living. Also included are experiments and demonstrations, puzzles, and games, a brief glossary, and a short bibliography.

Volume II, Activity Guide for 4-7, contains an introduction to our national energy problem, energy activities and demonstrations, discussions of our major energy resources, conservation activities, a glossary, and a teacher's resource section.

Volume III, Activity Guide for 8-12, contains a brief introduction to the energy crisis, and classroom activities and discussion ideas for students in all areas of instruction. Also included are activities for club and community involvement, and a teacher's resource section.

Washington State Department of Public Instruction
Office of Environmental Education
Old Capitol Building
Olympia, Washington 98504

Create Tomorrow. . .Today, 1974. Developed as part of Washington State's Energy Awareness Program, this book offers guidelines and suggestions for creating an awareness of energy problems. The materials were developed to enrich regular classroom programs. Included are activities for both elementary and secondary students, graphs, and charts, and other resources which would enhance the energy program.

Energy, Food and You, 1977. An interdisciplinary curriculum guide for secondary schools. Activities focus on global food problems, energy and resource use, the U. S. food system, and energy-efficient alternatives. An excellent topical treatment with personal management focus.